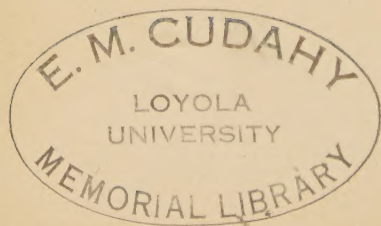


THE PERMANENT PALETTE



MARTIN
FISCHER



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ELEMENTARY PRINCIPLES OF
LANDSCAPE PAINTING

By John F. Carlson

THE PERMANENT PALETTE

By Martin Fischer

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by

Martin Fischer

*Member of the Duveneck Society of Painters and
Professor in the University of Cincinnati*



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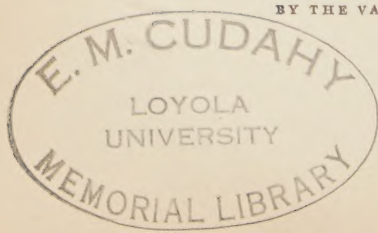
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To

LANGLEY PORTER

*provider of coffee and doughnuts
in the hour of need*

Modern pictures have not lasted as many decades as those of the old masters have lasted centuries. To these old masters we must therefore return.

A. Böcklin.

PREFACE

I have been asked to put down in these pages some remarks which I have made at different times to oil-painting friends of mine patient enough to listen. They have informed me that the ideas expressed were new to them and that through publication they might be made of service to a larger group of painters. I lay small claim to originality for what is printed here—I shall refer to various excellent writings as I proceed—but the choice which has been made of the available material is the expression of personal judgment and experience. This judgment, however, has this in its favor, it is free from the ordinary bias of education. I painted for several years before any professional tried to teach me and I took up the matter originally not because I thought myself capable of painting pictures but because I had a scientific interest in the materials of which pictures are made and the principles underlying their production.

MARTIN FISCHER

Cincinnati

April 17, 1930

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THE PERMANENT PALETTE

I

INTRODUCTION

Some years ago I heard JOSEPH PENNELL say in a lecture on lithographing that modern thought had not added an iota to the process since SENNEFELDER had invented and described it in the late eighteenth century. It seems to be true of the rest of modern art. Not only the "story" but the technique of all the fine arts seems "already complete." If the following pages are, therefore, of interest, it can only be because they emphasize a return to and a knowledge of a technique which was good, which is better than an existent one—and forgotten.

Oil painting as a craft is today what it has been since its beginning—a scheme for the production and the tying together of a series of color-reflecting surfaces. These surfaces are composed of minute particles of colored pigments held together by a binder. Since the invention of oil painting, this binder has been linseed oil. The similar binding together of the same colored particles by plaster of Paris constitutes gesso; by mortar, fresco painting; and by gum arabic, dextrine, glue, egg white or some similar material derived from plants (like fig milk) or animals (like the casein of milk) water color or tempera painting. These pages limit themselves to a discussion of oil painting though what is said may be applied with little modification to water color, tempera and gesso.

The creative artist intent upon the expression of his emo-

tion in painting is quite understandingly impatient of any discourse on the matter of the "ground" upon which he paints, the essential nature of oil painting, or the chemistry and manufacture of the pigments or vehicles which an eager salesman or a temperamental teacher wishes him to use. He is interested in results, he tells us, and methods mean nothing to him.

Historically, this impatient one has the old master against him, for the latter was primarily a craftsman and not ashamed of it. His apprenticeship began at fourteen or fifteen, lasted many years and was devoted not to artistic drunkenness but to the hard labor of grinding pigments, sunning oils and painting grounds. When he was finally admitted to a guild, it was not because he knew what, but because he knew, with conscience, how!

If history can not alter a modern's point of view, a visit to any large gallery will accomplish it. Out of a room headed by the inscription "XV and XVI Centuries" he will by himself pick the DÜRERS, the HOLBEINS and the CRANACHS and when he comes to ask himself why he has done this it will be not on the basis of drawing or composition—for many of their contemporaries were quite as good in these directions—but on the basis of their color. And yet these contemporaries had access to the same raw materials for painting as did those whose work has not gone gray or greenish-yellow. The canvases of RUBENS come a century later to preach a similar sermon. Obviously, to the artist who believes that he has something worth saying, the technique of his art *is* of importance if he does not wish a succeeding generation to misunderstand him.

It is known even to the beginning student of our day that

less than half a century has served to wipe out the color accomplishments of many of the masters of 1800—solely because they swallowed the sweet poison of bitumen—and that a few decades have dulled our WHISTLERS and DUVENECKS. The fact is the more tragic in WHISTLER'S case because he made every effort to learn from the available sources the principles which lay behind his pigment mixtures and his painting technique to assure the permanence of his productions. In our day we are reduced to a state in which the time from one spring show to the next suffices to dull the brilliancy of a travelling canvas, and this in spite of the fact that the number of our materials is larger and their sources, qualities and properties are better known than ever before.

Logic would demand that we begin the discussion of oil painting by taking up the ground upon which the painter paints, to enter then into the nature of oil painting itself and to finish with the pigments. We will, instead, reverse the order. The painter, for the most part, buys his ground ready made, is uninterested in the nature of oil painting so long as his picture dries sufficiently between painting periods and worries about the pigments which he uses only until the manufacturer has assured him that his prepared list is "permanent."

II

THE CAUSES OF NON-PERMANENCE

What does a manufacturer mean when he states that his pigments or tubes of prepared paint are "permanent"? Ordinarily not much more than that exposure of the pure pigments to light for a short time (a few months at most) does not change them much. But permanence to (a) *light* even when correctly determined is only one of the things to be considered. Others are the pigment's permanence (b) *to air*, (c) *to intermixture* with other colors, (d) *to reaction with the mediums* used in painting, (e) *to reaction with the grounds* upon which the colors are laid and (f) *to cold and warmth*. Except as the reflecting surface produced by the artist can withstand all these assaults and circumstances, and that for an indefinite number of years, his message is distorted or lost.

A few illustrations may make the problem clearer. An oil painting is ordinarily exposed fairly continuously to light. Suppose now that there has been used on the palette of the painter the highly-prized rose madder of the older artists or its modern (and better) chemical substitute alizarine. This root extract or its "coal tar" surrogate is slowly sensitive to light and under its influence fades from the painting. Other such tints and shades are even more sensitive. What really happens is comparable to the fading of the modern flapper's silks and satins which are dyed with the

Plate 1

The effects of light upon a series of commonly used water colors. The left half was kept in the dark, the right half was exposed for two years to studio illumination.



Plate I

same materials. To see what happens in a painting, Plate I should be studied.

Exposure of a pigment to air, especially if it contains "smoke," applies at least five tests to it. First, that of "sulphur" (really the action of hydrogen sulphide or sulphuretted hydrogen), then that of sulphur dioxide, sulphurous acid and sulphuric acid and finally those of carbonic acid (carbon dioxide united with water) and water. Under the influence of the first, lead white, for example, or any white pigment containing it changes to yellow or black. The hydrogen sulphide produced when coal or gas is burned acts upon the lead carbonate and lead hydroxide of which lead white is composed and changes them to lead sulphide which is yellow, orange or black. How quickly such a change is brought about may be observed in the color change which a frame house painted "white" in the ordinary way shows in the course of a year. It does not merely get "dirty" but actually "yellows" or goes gray. Sulphur dioxide, especially in damp air when it unites with the water to form sulphurous acid, is a powerful "bleaching" agent and as such will do away with those tints derived from the madder and alizarine group of pigments. Sulphurous acid when united with the oxygen of the air becomes sulphuric. This, too, is very destructive (so far as their original color is concerned) to various coal tar dyes. Such acid action extends even to the carbonic acid of the air which is, by itself, strong enough to affect some coal tar colors. Moisture, when it can penetrate a badly oiled or varnished picture, is bad chiefly because it speeds up all the reactions between the air and the pigments, as already described, as well as those between the pigments themselves. It should be borne in mind that the action of

these things need not make itself felt upon your canvas over night; but an atmosphere is something which is there all the time and works even after you are tired and continues to do so even when you are dead. The effects of a polluted atmosphere upon a series of oil pigments are shown in Plate II.

A third most important element in the permanence of a picture depends upon the chemical reactions of the pigments with each other. Whenever two pigments are mixed it is highly probable that two different chemicals are being rubbed into each other. If the two can act chemically upon each other they produce a third material and this third is not likely to have either of the colors of the originals which were placed upon a spot. Suppose you mix Chinese vermilion (which chemically is sulphide of mercury) with flake white (which is a mixture of lead carbonate and lead hydroxide). The sulphide portion of the vermilion slowly unites with the lead to produce lead sulphide which is dirty yellow or black. The picture thus painted therefore "yellows" or "darkens." If zinc white is used instead of lead white, a similar chemical change occurs, but the resulting zinc sulphide is practically white (it is really an extremely pale yellow) and so we say that the picture in this spot is "permanent."

Instead of reacting with another, a pigment may react with the medium or mediums used in painting. What happens so far as linseed oil is concerned we shall see shortly. Many artists and manufacturers are not content, however, to limit themselves to the use of linseed oil pure. Frequently other oils or various varnishes are used. In addition, "driers"

are added. These are commonly lead compounds of some kind and they are convenient when sketching and rapid drying of a canvas is desired to permit the application of a second coat of paint. They are not, however, without after-effects. An artist who has scrupulously avoided white lead or some colored lead pigment because of its dangers has, with his drier, smeared this element all through his canvas. The air or a pigment like vermilion (sulphide of mercury) will now gradually "dirty" his whole work. The matter is made worse if he has used a natural rose madder, any of the synthetic madders (the alizarines) or a pigment derived from these. The "drier" slowly reacts with these glorious tints and turns them purple, brown or gray.

Reaction of a pigment with the ground upon which it is laid is a matter to be taken up later. It is a problem essentially identical with that just discussed and the results that may be expected are those consequent upon the reaction of the applied pigments with those which have been used to prepare the "grounds"; or the changes which may result from the pigments of the ground "working up" or "through" the paints laid over them. The matter is of greater importance in water color or fresco painting than in oil painting because the acid or alkaline nature of the paper, cement, plaster, mortar or other surface upon which the pigment is laid means everything for the persistence or non-persistence of the original color effect produced.

Temperature changes also play their part. Higher temperatures, in general, increase the rate at which a set of possible changes takes place while cold does the reverse. When exposed to the accidental extreme of overheating from

Plate II

The effect of a polluted atmosphere (essentially the effect of hydrogen sulphide) upon a series of oil pigments. The left hand portions of the painted boards were sealed under glass; the right hand portions, exposed. The pigments from top to bottom of the plate are:

- 1—Zinc white
- 2—Flake white
- 3—Cadmium yellow
- 4—King's yellow
- 5—Harrison red
- 6—American vermilion
- 7—Chinese vermilion
- 8—Scarlet vermilion
- 9—Chrome orange
- 10—Emerald green
- 11—Vert emeraude
- 12—Terra verde
- 13—Cobalt blue
- 14—Ultramarine
- 15—Chrome green (*a mixture of chrome yellow with Berlin blue*)
- 16—Permanent green (*a mixture of zinc yellow with vert emeraude*)
- 17—Mars yellow
- 18—Mars red
- 19—Mars violet



Plate II

a fire or a steam pipe, one pigment may come out unscathed while another goes to pieces. The green of terra verde, for example, goes yellow on heating but that of chromium oxide (vert emeraude, viridian) comes out unscathed.

III

CLASSIFICATION OF THE PIGMENTS AS USED IN OIL PAINTING

Among painter, trader, manufacturer and chemist—all of whom contribute to the making of a modern masterpiece—the technique of oil painting loses itself in a sea of words. In order to arrive at a common terminology and understanding, the following introductory remarks may not be out of order.

No classification of the materials used by the oil painter is entirely satisfactory because no one scheme seems capable of being carried through without contradiction. The following represents a useful one and is approximately correct.

The painter distinguishes between *transparent*, *semi-transparent* and *opaque* pigments. It is perhaps the best basis for a first classification from the painter's point of view.

The opaque pigments are, without exception, dense particles of colored material. Since the first efforts of primitive man at color expression, these pigments have been made by picking up colored earths or crystal masses and grinding them. Such were the yellows, green-blues and reds of the old Egyptians; the orpiment, lapis lazuli and cinnabar of the Italians; and the rouge of the American Indian. These particles of natural color were and are, obviously, the same "through and through." These pigments are still known as the mineral colors. The pigments when used as found in nature have a property which is lost when they are, as today,

made artificially. The latter are usually produced by adding to each other two chemicals dissolved in water. The materials react with each other to produce an insoluble third material which is the colored pigment desired and which falls to the bottom. Such precipitate is then washed with more water, dried and ground in oil. The particles of color thus produced are "naked." The chemically identical substance found in nature is usually much less exposed, the pigment particles not infrequently being embedded in glass-like earthy material. This is true, for example, of the blue in true lapis lazuli or the yellow iron oxide or hydroxide in a natural ochre. While the pigments obtained directly from nature are thus less likely to be as bright as such as can be artificially produced, they have the advantage of being sealed in cases (aluminium and other silicates) which allow no other chemical to act upon them. Nor can they so readily act upon their surroundings, that is to say upon other pigments, with which they may be mixed. This explains, in part at least, the lasting effects obtained by the first painters. They mixed cinnabar (sulphide of mercury) for example, with white lead which should in the years have given them a yellowish or grayish white and yet such changes are largely missing. Whatever color shortcomings their palettes may have had, these were compensated for by complete permanence.

The semi-transparent pigments are also particulate colors and "mineral." Generally speaking, however, the pigment particles are smaller than in the opaque and the best examples (like transparent oxide of chromium or viridian) show a definitely clear crystalline structure. The result is, that ground in oil, such pigments keep a glass-like trans-

parency, and all of them, when diluted with a white, for example, reflect light more purely (and so look "brighter") than coarser particles of chemically identical substances.

The frankly transparent pigments of the oil painter are the most finely divided, in fact when mixed with oil they are not merely "suspended" in this fluid as are the opaque, but may actually be "dissolved" in it. Technically put, these pigments are "molecularly" divided in the oil in contrast to the semi-transparent which are "colloidally" divided and the opaque which are "coarsely" dispersed. In contrast to the last two classes which are usually of mineral origin, the transparent pigments *are always of organic origin*. Thus rose madder is obtained from the madder root, Indian yellow from the excrement of various animals, and their modern chemical substitutes from the decomposed vegetation which constitutes crude oil or the tar of coal. Instead of being simple in chemical composition as are the mineral pigments, the transparent ones are all complex. In general they constitute the group of the "dyes." A dye dissolved in an oil and used in this form constitutes a "glaze." The tube paints prepared from such dyes for the oil painter are not, however, such simple solutions. In water color painting these dyes are painted upon a white paper, the dye staining the white cellulose of which paper is composed. The dyeing of cotton or wool is the same sort of process. When intended for oil painting the dyes are used to stain particles of white earth. This process constitutes the manufacture of "lakes" and it is as "lakes" that the oil painter usually uses the "transparent" pigments which we are now discussing. By being converted into lakes the original transparency of the pure dyes is greatly reduced—just as in water color painting the orig-

inal, more transparent Indian yellows, carmines, madders and indigos are made "opaque" by mixing with Chinese white.

The complex organic materials which constitute the dyes show a high tendency to decompose (and so to change in color) in contrast to the mineral pigments which, in poetic phraseology, are as permanent as the hills themselves from which they were originally dug.

If these general remarks are kept in mind, the oil painter's prepared pigments may be categorically arranged about as follows:

OPTICALLY TRANS- PARENT	OPTICALLY SEMI- TRANSPARENT	OPTICALLY OPAQUE
Organic in composition	Usually mineral in composition	Mineral in composition
Oil Soluble	Not soluble (particulate)	Not soluble (particulate)
Very finely (molecularly) divided	Less finely (colloidally) divided or crystalline	Coarsely divided
Predominantly useful as "glazes"	Low or no glazing value	Opaque coverers
Employed in oil painting as "lakes"	Employed directly as colored particles of pigment	Employed directly as colored particles of pigment
Least permanent of the pigments	Most permanent	Most permanent
<i>Examples:</i> Rose madder (natural) Geranium lake (synthetic) Bitumen or bister	<i>Examples:</i> Pale Cadmium yellow Transparent oxide of chromium (viridian)	<i>Examples:</i> Lead or zinc white Ivory black Yellow, red or violet ochre

IV

CHOOSING A PALETTE

What, now, is the conscientious painter, suddenly invited to express himself in paint, to do?

The fifteenth and sixteenth century masters had at their command perhaps ten or a dozen pigments. Since that day the number has risen, though gradually at first, so that some twenty were available by the middle of the last century. In our half century the pigment list has grown by such leaps and bounds that various manufacturers of artists' colors now offer the artist a hundred; and one, by actual count, offers five hundred.

The painter of our day should remember that not every change with time is necessarily a step forward and so does well when he holds firmly to the religion of his historic masters and broadens this only as his personal knowledge and experience show him better ways. The Renaissance masters did pretty well with their few pigments and, since we know what time, air and a hard existence have done to their productions, their palettes may still, when doubt exists, remain our sheet anchor. Not that some even of the great did not fall into error, but modern science has told us why. We may, therefore, substitute in the case of such errors the sounder knowledge of our day for what they could learn only through practical experience.

It is true, too, that the last century has given us some definite additions to the old masters' palette which have improved it. Oxide of chromium (vert emeraude, viridian)

made its appearance about 1838 to increase enormously the beauty of our greens, and safely; and the synthetic (coal tar) alizarine of our day is infinitely superior, because purer, to the natural products (the madders) used by the older painters. But with very few such modifications the list even for the fine arts painter of today comes to a close. If the color merchant goes on, it is for mischievous reasons. That he should go on is, of course, partly the fault of the painter himself who will risk his reputation on what has been untested by time; but, in major portion, it is that of the dealer.

It is a good rule for the painter to eliminate everything from the manufacturer's catalogue which bears a name unfamiliar to him or the content of which is not wholly disclosed to him. These are the patent medicines of the fine arts and an artist, like a doctor, ought to know what he is using. Unfamiliar names are too frequently but catch words under which standard pigments or mere mixtures of such are sold at fictitious prices or, worse, they are straight proprietary names for materials whose quality is at least untested, if not actually poor.

The best answer to the artist's cry for pigments does not yield—and it must be confessed at once, cannot yield—all that he desires. That his work may last, he must use only such pigments as will bear mixture with each other, resist the effects of the air to which they are exposed and be incapable of reaction with the ground upon which they are laid. It requires a knowledge, therefore, of such elements of chemistry as have been discussed in a preceding section. But from an emotional point of view the artist's difficulties are still greater. He seeks to reproduce the effects of light,

especially the effects of colored light and here he is tempted by the modern color manufacturer's display of brilliant pigments. The modern dye chemist offers yellows, reds and violets which, painted upon a suitable surface come uncannily close to those spectral values which the artist may have observed when ordinary white light is passed through a prism and is thus made to yield its famous rainbow.

The modern oil painter had best begin by refusing to use *all* these so nearly spectral colors. Really beautiful palettes may be prepared from them but up to the present not one yields permanent effects. These pigments, prepared for the most part by dyeing fragments of white earth with yellows, reds, purples, greens and blues of the coal tar dye chemists are not unlike the similar prints of these materials upon white paper as used in modern lithography, for example, or in "three color printing." What happens may be seen in the effects of air, moisture, light and smoke upon the colored spreads of our billboards or upon the "colored reproductions" of the masterpieces of our painters when such are hung up about the studio instead of being kept embalmed in portfolio or "art library." The latest coal tar dyes (the so-called "anthracene dyes") are more permanent to light than some of the older ones, but they are still subject to fading, presumably because of the action upon them of hydrogen sulphide, sulphurous and sulphuric acid, always present in smoky air. These spectrally seductive colors are all "organic" in nature, and represent therefore chemically complex compounds. Since all such compounds show in high degree a tendency to decompose into simpler ones, they tend in equal fashion to make for change in color and so non-permanence of the painted surface.

V

LIGHT AND PIGMENT MIXTURE

More than one of the masters in modern color technique have been fascinated by the charms of the coal tar chemist's colors because he was taught or came to believe that the mixing of such spectrally true pigments had something in common with the mixing of the "lights" and "colors" which he observed in nature. What the physicist means by "light" and "color" and what the artist understands under such terms are totally unrelated things and must be kept apart.

A deal of nonsense has sprung from this confusion of the physics and physiology of light with the business of light perception by the artist and his attempt, through pigment mixture, to reproduce the effects observed. *Light mixture* and *pigment mixture* have nothing in common with each other; the laws of each are different, should be learned as such—and be kept apart. The laws of light mixture are fairly well understood; the effects produced by pigment mixture must be learned empirically and be thus carried in the mind of the artist.

By white light the physicist and physiologist mean that "mixed" light which characterizes ordinary clear daylight. "Darkness" means the absence of such light. The white light may be shown to be "mixed" by passing it through a prism. The prism bends the different waves of which the white light is made up, the short waves (the violet) suffering most, while the longest (the red) are bent least. The result

is a separation of the mixed white light into its waves of different lengths thus yielding the various "colors" which constitute the rainbow, at the two outer edges of which are found the violet and the red, with indigo, blue, green, yellow and orange lying between.

A surface is said to be "colored" when, under illumination by white light, it "absorbs" some of this and "reflects" the rest. A red barn is red, therefore, because it absorbs all the colors of white light, excepting red, which it reflects. When now several such "monochromatic" reflected lights, or, in general, several colored lights are *mixed*, white *light* is again obtained. For this purpose not all the colors of the rainbow are necessary but only those which are complementary. Thus reflected sea green *light* with reflected bright red *light*, yields white *light*; reflected yellow with reflected pure blue yields white *light*, etc.

The pigments and their mixture yield us something totally different. A *white pigment* is simply something which applied to a surface *reflects* all the light thrown upon it, absorbing none. A white pigment, in other words, reflects ordinary mixed white light in toto. A colored *pigment* reflects those portions of mixed white light which we call the color of the pigment, absorbing all the rest. When light mixture and pigment mixture are compared, they show nothing in common. While red and green *light* mixture produces white, red and green *pigment* mixture produces something resembling black. A mixture of lights always increases luminosity; a mixture of pigments always decreases this. A mixture of colored lights tends toward light; a similar mixture of pigments, towards darkness.

The oil painter produces a reflecting surface which will

most nearly produce the sensation of ordinary daylight and in greatest intensity by painting it pure white. He produces the sensation of complete absence of such light by painting it pure black. He can produce the sensation of different degrees of illumination by mixing the two, in other words, by a series of grays. If now he wishes to produce the effect of a colored light, he uses a pigment which most nearly approximates in its properties of reflecting light the color he has observed. Theoretically he should be able to express the quantity of that color in nature by using more or less of the proper pigment; and its intensity under different degrees of illumination by mixing it with pure white. Conversely, he should be able to express that color under decreasing intensities of illumination by mixing it with black. This is, of course, the very scheme that has been used by painters since the days of the first masters though, as every one knows, the matter does not work out as satisfactorily in oil painting practice as might be wished. When a vermilion or yellow is diluted with white, for example, the mixtures show a tendency to appear gray and similar dilutions with black show not only a reduction in color intensity but a change in the color itself. In spite of these shortcomings white and black are nevertheless indispensable to the oil painter. Of the several pigments offered, which shall he use?

VI

THE WHITES

The white which the oil painter would like most to use is lead white (also known as flake white or silver white) and chemically a mixture of lead carbonate with lead oxide or lead hydroxide. On the basis of its immediate qualifications it is most agreeable. It is a fairly good reflector of white light (appears white and not colored in ordinary white light), covers well any spot upon which it is painted and does not crack after drying. It has, moreover, a tendency to hold together and manifests a "pull" under the painter's brush which he likes. The reasons for these qualities are interesting. Lead white after grinding in linseed oil slowly acts upon it and unites with it to form a lead soap. This lead soap is a cohesive, adhesive and "pull" material—it is, in fact, the material of which the sticky surface of the ordinary adhesive plaster is made. The useful qualities of such a white for producing a good painting ground are self-evident. But lead white, when exposed to a smoky atmosphere (hydrogen sulphide) or when mixed with other pigments composed of sulphides (for example, vermilion, cadmium yellow or cadmium orange) turns yellow, gray or black. For these reasons lead white is rejected.

The best white pigment for the oil painter is zinc white (essentially zinc oxide). It reflects white light less perfectly (is faintly blue) than lead white, covers less perfectly, and its "pull" and cohesiveness are inferior to those of lead.

Hence its reputation, too, that, with time, zinc white shows a tendency to crack or chip off. The scientific reason for all this seems to be that the zinc soap formed after grinding zinc white in oil is a much less gummy and cohesive material than the already described lead soap. Zinc white, however, is a reliable, permanent white. The sulphides of the air or of pigments mixed with it leave it white.

Mixtures of zinc white with lead white are sold under various names. It is argued that such bring together the virtues of both pigments. Unfortunately, they do not dispose of the chemical defects of the lead pigment, wherefore, to my mind, such mixtures should not be used.

Chalk white (calcium carbonate) and barium white (barium sulphate) need consideration. The first named is a poor reflector of white light, yields a dry and crumbly soap and therefore a dry and crumbly paint after grinding with linseed oil. It is also very sensitive to acids, either those which may be present in the air or in any badly washed colored pigments containing such which may be mixed with the chalk white. Barium white (barium sulphate) has better qualifications. It is among the whitest, if not the whitest, of the whites. Chemically, too, it is the most resistant of the series (unaffected by light, air, acids, smoke or other pigments). Its defects are those of poor covering power and absence of cohesiveness. If and when it forms a soap with linseed oil, this is of a dry and brittle kind.

Barium white has been mixed with zinc white or lead white to overcome the defects of the pure barium white. The disadvantages of the lead white cannot be lost in this fashion, and zinc white is too low in its qualifications as a soap producer to be able to spare any to barium white. Barium white

is a monetarily cheap material while lead and zinc are expensive. Over-emphasis upon the merits of barium white is therefore always to be looked for from the ordinary manufacturer.

Artists have recently been urged to use titanium white (titanium oxide). The material is not as good a reflector of white light as is zinc white, and has a distinctly yellowish tinge. It is permanent to light and air, has great covering power and a good pull. What appears upon the market as titanium white is usually a mixture of this material with much barium sulphate. Such mixtures are still permanent and have great covering power but show an increased tendency to crack and chip off.

VII

THE BLACKS

The black of choice of the oil painter should be ivory black. It is the oldest of the blacks and was made originally from ivory chips (a form of bone) which were charred by being heated in the absence of air. Bone black is made in similar fashion from bones, and charcoal black from wood. While chemically all three are much the same—they owe their blackness to the black carbon which they contain—ivory black is the blackest and smoothest of the three. The carbon particles are most finely divided in this pigment. All three blacks contain an enormous percentage of white or “colorless” ash—eighty percent in the case of bone black. Still the carbon has such intense covering power that even this material looks pure black.

Other forms of carbon black are graphite and lamp black. The naturally found graphite ground in linseed oil constitutes the former. It is an absolutely permanent color and since all forms of pure carbon are chemically among the most inert of substances it may be mixed with all other pigments without fear of change. But graphite black is not a “clean” black in the painter’s vocabulary but has a bluish or slatey cast and so finds little favor in the fine arts. Lamp black, on the other hand, gives the blacks or grays which it produces a warm tone which the painter is all too anxious to have. Unfortunately, these warm tones are not due to the brand of carbon which this black contains, or its higher

percentage in the pigment as used, but to the presence of traces of tar-like substances which endanger the future of anything painted with such a black. Lamp black is made by allowing any smoking flame (like that of burning petroleum or natural gas) to condense its smoke (carbon) upon a cold glass plate. Theoretically this is pure carbon, but actually there condenses with this carbon a series of tar-like or bitumen-like substances (hydrocarbons) which, mixed with white, give this a yellowish or reddish cast. What does this is really a "coal tar product," in other words, a substance or a series of substances naturally produced which, artificially made, constitute the coal tar dyes. But these, as so often emphasized, are light- and air-sensitive, so that the "warm tones" derived from such a black are almost certainly subject to future change. Lamp black is frequently "washed" in order to get rid of such adhering substances but it then loses all qualities which make it preferable to the old and tried ivory black.

VIII

THE COLORED PIGMENTS

For his colored pigments the artist needs, besides his white, the minimum of a blue, a yellow and a red, from which, as commonly said, he may through mixture derive "all colors." What will give us the brightest and yet most air resistant and chemically inert series? It is, I think, the following:

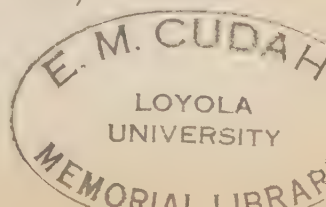
Ultramarine blue	(colloid sulphur)
Pale cadmium yellow	(cadmium sulphide)
Cadmium red	(cadmium sulphide and cadmium selenide)

Before discussing this choice, we will add two further pigments, namely:

Cadmium middle	(cadmium sulphide)
Cadmium orange	(cadmium sulphide)

For a reason which will appear later, I am in the habit of placing these upon a palette in the following sequence.

Ivory black (if any black is used)	(carbon)
Ultramarine blue	(colloid sulphur)
Zinc white	(zinc oxide)
Cadmium yellow pale	(cadmium sulphide)
Cadmium yellow middle	(cadmium sulphide)
Cadmium orange	(cadmium sulphide)
Cadmium red	(cadmium sulphide and cadmium selenide)



Now why this choice? The pigments are, first, absolutely light fast. Second, they are fairly bright, in other words, they approximate spectral effects as closely as can be managed under our primary demand for permanence. Third, the total palette as thus far arranged is incapable of chemical reaction within itself or with the elements of the air. There is given after each of the pigments its essential chemical composition. From yellow through the red we have only sulphides, in other words, a series of chemically identical compounds which can therefore not react with each other. Neither can these pigments be changed by air, in which the chiefly active material is again a sulphide (sulphuretted hydrogen, H_2S). Black, if used, introduces only carbon which, in its elemental state, is the most inactive of all substances. According to our best knowledge the blue color of ultramarine is due to finely divided elemental sulphur ¹ (so-called colloidal sulphur) and this encased in a glass-like matrix. Such sulphur cannot react with the sulphide colors or the air nor can reactions occur in the opposite direction. This makes the whole palette arrangement permanent down to the white. But should reaction occur between the sulphide colors or the air and zinc white the result would leave the picture effect undisturbed, for zinc sulphide is of such a pale yellow that it remains to all intents and purposes white.

Use has been made in this palette of a principle which has only been discovered in recent years and one which I believe will help much in the development of the permanent palettes of the future. This is expressed in the fact that *one and the same chemical substance shows a varying color*

¹ WOLFGANG OSTWALD: Theoretical and Applied Colloid Chemistry. Translated by FISCHER, 2nd American Ed. 201, New York (1922).

*range depending solely upon the size of the particles constituting the pigment.*¹ Pale cadmium yellow is only a more finely divided cadmium sulphide than the ordinary (middle) yellow cadmium and this is finer than the succeeding orange cadmium. Still coarser cadmium sulphide appears red which explains the use of cadmium red in this series (though cadmium red is not pure cadmium sulphide but a mixture of this with cadmium selenide). Chemical units yielding complete sequences in color (from pale yellow through orange and red to blue) are known, though no such complete cycles have as yet been prepared for the artist. Obviously, when they arrive they will dispose completely of one element of non-permanence in painting—that due to the reaction of the pigments with each other.

Let us ask at once regarding the shortcomings of this palette when turned to use. Two facts appear—there is insufficient variety in the reds and the colors derived from admixture of cadmium red with blue or cadmium orange with blue lack transparency. Before resorting to the usual method of escape out of the difficulty—by the introduction of alizarine into the palette—a safer though not so completely satisfying one is found in the addition of vermilion between the cadmium orange and the cadmium red. Vermilion is a sulphide of mercury (HgS) and is, therefore, a chemically safe addition. But this compound, like the cadmium sulphides already discussed, also runs from a yellowish orange through an orange to red. *The most useful enlargement of the palette range is obtained by a careful selection of the yellowish or orange shades of vermilion.* This is by no means the shade ordinarily found in the manufacturer's tube. The

¹ WOLFGANG OSTWALD: Kolloid-Chem. Beihefte, 2, 409 (1911); Theoretical and Applied Colloid Chemistry. Trans. by FISCHER, 2nd Amer. Ed., 65, New York (1922).

best comes from China, whence the name Chinese vermilion. But what is labelled Chinese vermilion is rarely the real material. The Chinese make their yellowish vermilion by an effective though primitive and dangerous process. Their white brothers make it scientifically, safely and poorly.

We can now increase the brightness of the green which this palette yields by using the so-called transparent chromium oxide (vert emeraude, viridian). While in a chemically different series, it is, nevertheless, incapable of reacting with any of the pigments thus far employed.

Let us complete this discussion of the absolutely safe pigments (with their relatively low transparency) before turning to a discussion of the more seductive ones.

Relatively long sequences of color (though of lower tonal value) may be obtained from certain other chemical entities. This is true, for example, of the iron hydroxides or iron oxides which give character to the so-called earth colors. A series which, if bright enough, may be substituted for the yellow to red members of the palette as thus far described, or added to them, is the following:

Yellow ochre	(light or (iron oxide or hydroxide)
dark)	
Gold ochre	(iron oxide or hydroxide)
Raw siena	(iron oxide or hydroxide)
Raw umber	(iron oxide or hydroxide
	with manganese oxide)
Red ochre (Indian red,	(iron oxide)
light red)	
Burnt siena	(iron oxide)
Burnt umber	(iron oxide with manga-
	nese oxide)

An artist will probably not require this entire list but he may use any portion or all of it as he wishes. Its members constituted the very sheet anchor of the old masters and reliably so. These earth colors are literally only brightly colored clays and therefore as immune to the action of air, water and chemicals as is the earth itself. When strongly heated the yellow earths change to red or purple. This transformation is ordinarily said to be a change from the iron hydroxide present in the first members of this list to the red iron oxide which characterizes the later ones. The change may, however, be only that from a more finely divided iron oxide in the former to a coarser one which is red or purple.

This series of earth colors is repeated in somewhat brighter form in the so-called Mars colors.

Mars yellow	(iron oxide or hydroxide)
Mars red	(iron oxide)
Mars purple	(iron oxide)

The Mars pigments are brighter than the natural earths because they are prepared artificially from pure grades of certain iron salts (like iron sulphate or iron alum) which are simply heated. Depending upon the intensity of the heat applied and the length of such exposure a series of beautiful yellows, oranges, rouge reds and a bluish-red are obtained, the first named being generally considered as the very finely divided state of an iron oxide which in the "blue" form reaches its greatest coarseness.

IX

THE TRANSPARENT PIGMENTS

We return, now, to the deficiencies of this palette as thus far developed. It is brighter, far, than that of the early masters, but has, as previously stated, a weakness in the reds and a certain lack throughout of that "transparency" and "luminosity" which painters have at all times wished. The older painters met the situation by the introduction of rose madder into their palettes, a practice subsequently increased by the introduction of other transparent pigments (chiefly in the realm of the yellows) like Indian yellow and gamboge. Modern chemistry has analyzed these pigments of vegetable or animal origin and has produced synthetically better and purer chemical substitutes. Alizarine is the modern substitute for rose madder and a long list of coal tar yellows today are offered to replace the organic yellows of the older painters. Modern chemistry produces these beautiful pigments from certain chemical fractions found in tar (phenol, cresol, aniline, anthracene, etc.) whence their generic name of the "coal tar" dyes. For oil painting the dyes cannot be used as produced, wherefore a practice is followed which in principle was used even by the first vendors of the natural products, *the dye is precipitated upon a white base of some sort. The combination thus made between a white ground substance (usually a white "earth" artificially produced, like aluminium hydroxide or some*

*other metallic hydroxide) and any of these "coal tar" dyes constitutes a "lake."*¹

Every modern painter would like to use such materials and many do. The tints of flowers, the colors of a rising or setting sun, the reflected lights in a portrait may be better expressed by utilization of the color qualities of these lakes than by using any of the absolutely reliable pigments or their mixtures that have thus far been described. But their recommendation by pigment manufacturers to the artist and their employment by him are more responsible for the fading, graying, color "sweating" and darkening of the masterpieces in painting of our half century than any other single element at work in the technique of modern oil painting.

First, many of these organic dye substances (whether natural or artificial) are light sensitive. All suffer in years or months (as witness the faded skies in the TURNERS and the COROTS or the faded silks in the WHISTLERS) and many die in weeks or days. I remember a red barn in one of my paintings laid in in pure "American vermilion" (no doubt an eosine or "fuchsine" dye) which disappeared in two years.

Second, being of rather complicated chemical structure they tend, with mere time, to decompose into simpler bodies, naturally again with loss of color.

Third, such decomposition is enormously accelerated by deoxidizing or oxidizing agents; and various elements of the air (like sulphurous acid) or of other pigments (like chromium oxide, vert emeraude) are such.

Fourth, the combinations between these dyes and the bases

¹ At times, to heighten the color effect, a *colored* base is used upon which to precipitate the dye. Thus carmine may be combined with vermilion, fuchsine with red lead, etc.

upon which they are laid are not permanent. The dyes (whether natural or artificial) will leave the base to "dissolve" in the linseed or other oil used in painting. The dye therefore not only disappears from the spot where painted but migrates (diffuses) into neighboring regions. The painted spot therefore "spreads," "sweats" and "comes through" into regions and planes of painting where it is not wished.

Fifth, these dyes change color in contact with bases other than the uncolored "neutral" ones with which they were united originally. Manganese or lead, for example, changes the red of rose madder to brown or purple. This is, as a matter of fact, the method by which the dyers of the wool used in the old "oriental" rugs obtained their different shades. Depending upon the kind of earth or clay with which they treated their madder extracts, they obtained not only rose tints but rose purples and purple. The examples chosen are of direct interest to the modern painter, for he, too, is inclined to "brighten" the tone, say of his ochres, by mixing with them rose madder or alizarine. But this is to mix them with iron and the result is obvious—his sunlit cliffs are sure to show storm effects in a few years. Manganese is found in the umbers, but it is of even greater importance that this element appears in many "driers" as does, also, lead. A painter, therefore, who has avoided lead pigments upon his palette carries this element all through his painting (and so, of course, endangers all his madder or alizarine tints) simply because he uses a "drier" in his painting vehicle or has had the manufacturer put this into his so-called "boiled" linseed oil.¹

¹ See Page 68.

Sixth, the dyes are sensitive to slight changes in acidity or alkalinity. A little acid or a little alkali left in some badly washed pigment or in an oil, or present in a smoke polluted air will change rose madder or alizarine crimson, for example, to yellow or purple.

The obvious lesson to be learned from this discussion is that the *oil painter should forego as far as possible all pigments of the "lake" type*. This means all his "glazes" and all those "transparent" pigments which are obtained by dyeing white earths with the natural, organic, vegetable or animal dyes or their coal tar substitutes. These dyed white earths are, in other words as tricky as the similarly dyed textiles (white wool or white cotton) or paper (aquarelles or billboard spreads). The sacrifice to the modern worker in pigments is enormous but unavoidable.¹

If the painter in spite of these facts considers one or more lakes as indispensable to his art, then what substances and which schemes of painting offer him greatest hope of permanency?

The most useful enlargement of his palette, especially in the region of the reds and purples, and the greatest luminosity is offered him in the use of *pure alizarine* (as a substitute for the less pure and less reliable rose madder). This material usually comes to the oil painter as a union of alizarine (which is a complex organic substance of the empiric formula $C_{14}H_8O_4$ derived from a coal tar fraction

¹ WILHELM OSTWALD has devised from the modern coal tar dyes a series of *water color* pigments which when painted upon white paper yield a series of tints that approximate spectral light values more perfectly than any other pigments I know. The dyes seem all to be molecularly soluble in water (behave as "lakes," in other words); even the black seems to be such a "soluble" pigment. OSTWALD's pigments should appeal to an experimentally inclined artist. It must be added, however, that the pigments of his series which I have used are not light fast.

known as anthracene) with an aluminium earth (aluminium hydroxide). In this form the prepared pigment has a deep rose (slightly bluish) cast and represents the most permanent form in which this material may be obtained. Deviations in color toward purer rose tints on the one hand or deeper purples, blues or browns on the other are made by changing the type of earth with which the alizarine is combined. For such purposes tin, calcium, iron or chromium are used, the resulting tints being known as rose alizarines or rose purples or brown "madders." *It should be noted that the chemical elements just listed appear in the pigments on the painter's palette especially in the group of his "earth colors" so that the changes which a manufacturer induces in the production of his various tube colors are all likely to be produced spontaneously upon the painter's canvas if he carries his alizarine unthinkingly or too widely across his palette.*

The chemical constitution of alizarine itself can also be changed. A slight chemical alteration yields "purpurin," from which more definitely bluish pigments may be manufactured. The total series of such alizarine derivatives are sometimes referred to as the "anthracene" dyes or pigments and several such, as prepared by different manufacturers, carry protected trade names. These alizarine derivatives are fairly light permanent, but they are subject to great change when used in combination with any of several of the ordinary painter's pigments.

It needs to be emphasized finally that manufacturers call things "lakes," "alizarine lakes" or one or another kind of "madder" that have never known either the natural root or any element of the mother chemical, alizarine. The painter

does well in this field to forego the use of any material of which the manufacturer will not willingly give him the total composition.

If alizarine is placed upon the palette, how is it best used? It must, obviously, never be mixed with any of the earth colors. Nor may it be mixed with chromium oxide, transparent (viridian) or opaque. It stands mixture with all the remaining blues, yellows and oranges of the palette as above described and with zinc white alone. When a canvas carries the earth colors or some other pigment not compatible with alizarine or any of its derivatives, the areas of painting in which each is used had best be kept apart.¹

¹ The introduction and use of a "transparent" pigment—what I have here called a molecularly soluble one—in fine arts painting is a subject of much interest. The oldest masters had none. The first to be used was rose madder, which has its modern substitute in the chemically purer alizarine. The displacement of vermilion by rose madder with or over a yellow by the Dutch portraitists, for example, accounts for their non-permanence as compared with the work of the older masters. The work of those who employed madder has gone yellow because of the disappearance of the madder with time. RUBENS' flesh tints have held up because he mixed madder with vermilion.

About the period of 1800, bitumen came into use, since replaced on the palettes of many painters by various tar derivatives or "earths" containing tar-like materials such as mummy, bone pink or van Dyke brown. The modern school has resorted to the use of a whole series of chemically produced "lakes," the latest and best of which (because most permanent to light) are a series of anthracene dyes used to stain the various white "earths" found in nature or produced artificially.

It is of interest to speculate why the artist gets his more desired effects by using any lake. When two particulate pigments are mixed, the two colors appear side by side. Vermilion mixed with ultramarine may be represented therefore as follows:



The optical result is a purple color since white light cast upon these particles is reflected as red and blue which mixed give purple. But white light is also reflected which, added to the others, gives a total reflected effect which is *grayish* (purple). When a *transparent* red is used instead of the vermilion, the red covers the blue particle thus:



Light absorption occurs as before, so that purple is again produced, but no white light is bent out of its course and reflected with the purple. The purple is therefore not gray, but purer and deeper in tone. What is here said of red may in similar fashion (and with any other pigment besides blue) be said of the black or brown or yellow of bitumen, mummy, van Dyke brown, etc.

X

APPARENTLY SAFE "EARTH" PIGMENTS WHICH ARE TO BE AVOIDED

The search for materials which would broaden the possibilities of the painter's palette has yielded, during the last century and a half, a number of "earths" which in immediate effects yield more agreeable results than do the standard and tried-out "earths" of the old masters. Their origin from the earth and their designation would seem to guarantee their permanence and their safety, and still this is not the case. We may list under this heading the following:

Van Dyke brown
Bone pink
Bister (tarry soot)
Bitumen
Mummy

These materials are known and sold under a long list of synonyms. Van Dyke brown, an "earth" originally found in England, is also known as Caledonian brown, cappah brown, Spanish brown, Cassel brown or Cologne earth. It is even called "umber" at times. The material owes its pleasant transparency not to the peculiar properties of any "earth" which it may contain (essentially ochre) but to a fraction of organic material present in the native ground. All these browns come from peat districts, in other words, from earths containing more or less partially decomposed vegetable ma-

terial, tar-like in nature. Bone pink or bone brown contains a similar "tar" derived in this instance from the incomplete charring of the animal matter found in bone. When the soot condensed from a burning flame is not properly washed, it, too, contains tar-like material, such variety of soot or carbon black then being known as bister. Bitumen (or asphalt) is only the familiar tarry earth of our streets somewhat purified, and mummy is the similar material used in embalming, and dug out of the Egyptian mummies. It is usually mixed with more or less of the surrounding earth and the decomposed mummy itself so that, in this sense, it approximates van Dyke brown.

The important point is that *all these pigments owe their agreeable qualities not to the earths which they contain but to the accompanying organic "tars."* These tars are all oil soluble and so yield those smooth and agreeable "warm" tones in the grays, for example, which the painter prizes so highly. But on this account these tars also diffuse from one region in a picture to another, "sweat through" and—in the case of bitumen—never dry. The "tarry" origin of the color qualities of these pigments assures us from the start a transitory effect, for all such complex organic compounds are light sensitive and destroyed by the action of smoky air and certain other pigments.

The painter remains safe, therefore, only as he eschews this entire list.

XI

THE NATURAL AND SYNTHETIC LAKES

I give below some examples of natural and coal tar lakes which at various times and in various ways have found a place on some oil painter's palette. With the exception of alizarine, all are non-permanent even to light and alizarine may not be used with any of the earth colors which contain iron (ochre, siena, etc.). The list might be much extended, though such extension would represent little more than the addition of high sounding trade names. Even in the list as given, lakes of identical chemical composition are repeated under different names. I have written opposite each the material from which the dye element in the finished lake is derived. The ground substance and bulk of the lake is nearly always some natural or chemically produced uncolored or white "earth."

The following lakes are prepared from colored substances as found in nature.

Red madder	(from madder root)
Rose madder	(from madder root)
Rose pink	(from Brazil wood extract)
Carmine	(from cochineal)
Carmine lake	(from cochineal)
Scarlet lake	(from cochineal)
Crimson lake	(from cochineal)
Purple lake	(from cochineal)

Indigo	(from indigo plant)
Gamboge	(from plant rosin)
Indian yellow	(from urinary excrement, magnesium xanthate)
Yellow madder	(from yellow plant parts)
Yellow lake	(same as yellow madder)
Brown lake	(same as yellow madder)
Sepia	(from ink of the squid)

The only usable pigments in this list are the red and rose madders and, since synthetic chemistry has produced substitutes (the alizarines) for these which are purer, the painter had best use them. The remaining pigments are unreliable whether obtained from the natural sources here indicated or as coal tar substitution products now to be listed.

The following are chemical derivatives from different fractions of coal tar. The entire list, with the exception of pure alizarine red, should be learned only to be forgotten for, however tempting the first effects produced by these pigments, their life is not long.

Alizarine red	(from anthracene)
Madder lake	(from anthracene)
Rubens' madder	(from anthracene)
Fuchsine	(from aniline)
Rose aniline	(same as fuchsine)
Magenta red	(same as fuchsine)
Aniline red	(same as fuchsine)
Caesar red	(from aniline)
Geranium lake	(from aniline)

Solferino rose	(from aniline)
Eosine red	(from resorcine)
Fluorescine	(from resorcine)
Rose Bengal	(from resorcine)
Rhodamine	(from phenol)
Scarlet red	(an azo dye)
Bordeaux red	(an azo dye)
Mauve	(from aniline)
Aniline violet	(same as mauve)
Methyl violet	(same as mauve)
Indigo	(from benzene)
Thioindigo	(from benzene)
Malachite green	(from aniline)
Methyl green	(from aniline)
Brilliant green	(from aniline)
Aniline yellow	(from aniline)
Persian yellow	(from aniline)
Solferino yellow	(from aniline)
Aniline blue	(from aniline)
Aniline black	(from aniline)
Olive lake	(yellow lake mixed with some blue or brown)

The lakes prepared from aniline fade in weeks. The azo dyes stand up better but are still far from satisfactory.

The dye chemist offers the painter a new tone almost daily. While such recent discoveries are frequently guaranteed as permanent, it is obvious that not enough time has elapsed since their discovery to prove that such is the case. Thus far every adoption by the oil painter has proved disappointing.

The fine arts worker does well, therefore, to hold fast only to such as time has proved good, leaving experiments with new pigments to those who are not writing their life story with them.

XII

OTHER PARTICULATE PIGMENTS

There must now be considered some particulate pigments which in themselves are good but which we omitted from the painter's palette as thus far discussed. Why were they omitted, when may they be used and what are their qualifications?

A first argument in favor of the use always of the fewest possible number of pigments is resident in the fact that this reduces to a minimum the possibilities of any chemical reaction between them and so change in the color value of what has been laid upon a canvas by the painter. For this reason, too, the yellow, red and blue of even these few pigments should be chosen of as nearly identical chemical composition as circumstances permit. Hence the use of a sulphide yellow (cadmium yellow) with a sulphide red (cadmium red) and a sulphur blue (ultramarine); or an oxide yellow (yellow ochre) with an oxide red (red ochre) and an oxide blue (cobalt blue). A picture can rarely be completed with so short a list of pigments but this is the correct foundation upon which to build. The painter should not, in other words, pass thoughtlessly to tinctorially equivalent or even better yellows, reds or blues derived from chemically unrelated systems.

Cobalt blue is an oxide of cobalt. If its intensity is sufficient for the painter's needs it is a better blue to use with the earth colors, for example, than ultramarine. The light and

dark shades of this blue represent larger or smaller admixtures of the colored oxide with white earth (usually aluminium oxide). Cerulean blue is a cobalt blue still further reduced by the addition of aluminium oxide or another white earth (tin oxide). These blues may be safely added to the palette as thus far developed.

Cobalt green and cobalt violet may also be added if wanted or needed. Cobalt green is an oxide of cobalt mixed in or combined with zinc oxide. The latter is the standard white of our palette, and the cobalt fraction falls in with the other cobalts. Cobalt phosphate is the chemically characteristic element in cobalt violet. It is a mineral ash that may be safely used if its color intensity is sufficient. When adequate for such ends, it is a wholesome substitute for any lake that may be employed to provide the necessary violet.

Cobalt yellow (aureolin) is best left off the oil painter's palette. It is a complex cobalt compound containing potassium and is, therefore, somewhat water soluble. Many of the aureolins are not cobalt yellows but other yellows masquerading under the name.

Prussian blue (Berlin blue, Paris blue) is a cyanogen compound of iron (iron ferrocyanide). This pigment enjoys a good reputation though its complex chemical structure and its tendency to fade are against it. When the painter's technique and objects permit it, ultramarine or cobalt is, therefore, preferable.

The chromates of barium (lemon yellow) strontium (strontium yellow) and zinc (zinc yellow) are temptingly brilliant oil pigments. One would like to substitute them for the not always pale, pale cadmiums. It is best not to do so, for they all fade or discolor with time, due no doubt to their

rather complex chemical composition and interaction with other pigments (especially the "lakes").

Indian yellow (magnesium xanthate) is a much desired transparent pigment. Its complex organic composition and its tendency to darken counsel its omission from the permanent palette. True Naples yellow is lead antimonate and is best avoided because of its lead fraction. What is often called Naples yellow is a pale cadmium, a substitute, therefore, superior to the original substance.

Terra verde (Veronese earth) is an absolutely permanent pigment. It is a natural earth usually of Italian or Bohemian origin which is believed to owe its peculiar green tone to iron silicate. When strongly heated, the green color is lost, leaving behind a yellow-red, ochre-like earth (iron oxide).

All pigments containing copper (verdigris, malachite green,¹ emerald green²) are best avoided by the oil painter as exposure to smoke-polluted air or mixture with pigments containing sulphur (cadmiums, ultramarine) blackens them. The same is true of all pigments containing lead, from lead white through the yellow and orange lead chromate and the fiery red oxide (minium). This includes also the true Naples yellow which is lead antimonate.

¹ Green basic copper carbonate; not to be confused with the so-called malachite green of the dye manufacturers.

² Copper arsenite; not to be confused with vert emeraude which is chromium oxide.

XIII

SUMMARY

The discussion of the preceding pages leads us to the selection of the following pigments as those promising greatest permanence. Their arrangement on the palette may be any that the artist chooses but the following, in which ivory black is laid out at the extreme right on the palette, white in the middle and the earth colors at the extreme left, makes easy the memorizing of the few precautions which are added at the bottom of the list constituting the permanent palette. The additional or substitute pigments are arranged in such order and are so placed as to make easy their substitution for or replacement under any similar pigment in the permanent list.

THE PERMANENT PALETTE		ADDITIONAL PIGMENTS OR SUBSTITUTES	
Ivory black	(carbon)		
Ultramarine blue, dark	(colloid sulphur)	Permanent blue	(ultramarine, colloid sulphur)
Ultramarine blue, light	(colloid sulphur)	Cobalt blue	(cobalt oxide)
		Cerulean blue	(cobalt oxide)
		Cobalt green	(cobalt oxide)
		Cobalt violet	(cobalt phos- phate)
* Vert emeraude (chromium oxide transparent)	(chromium oxide)	Chromium oxide opaque	(chromium oxide)
Zinc white	(zinc oxide with carbonate)		
Cadmium yellow, pale	(cadmium sulphide)		
Cadmium yellow, middle	(cadmium sulphide)		
Cadmium orange	(cadmium sulphide)		
Orange vermilion	(mercury sulphide)		
Cadmium red	(cadmium sulphide and cadmium sel- enide)		
<u>Alizarine crimson</u>	("coal-tar")		
Yellow ochre, light	(iron oxide or hy- droxide)	Mars yellow	(iron oxide or hydroxide)
Raw siena	(iron oxide or hy- droxide)		
Red ochre	(iron oxide)		

THE PERMANENT PALETTE

ADDITIONAL PIGMENTS OR
SUBSTITUTES

Burnt siena (iron oxide)

Mars red (iron oxide)

Mars purple (iron oxide)

Terra verde (iron silicate)

Burnt umber (iron oxide and
manganese ox-
ide)

1. When alizarine is *not* used, the remaining pigments may be mixed in any way desired.
2. When alizarine is used, it may be mixed with any pigment standing above it, excepting chromium oxide which destroys it.
3. Alizarine must not be mixed with any of the earth colors (those pigments listed below it).

XIV

PAINTING FOUNDATIONS AND GROUNDS

A painting can obviously not last longer than the foundation upon which it is laid. The old masters painted on wood and for their larger pieces chose canvas. At a later period metal sheets were introduced.

If adequate in size, wood still remains the best of painting foundations. Objections to its use arise from its tendency to crack, to become worm eaten and to swell or curl with changes in temperature or moisture content of the air. Worms may be kept out by painting the backs of the panels with red lead in linseed oil. The other difficulties are largely guarded against by observing the following.

Thoroughly seasoned wood is best, wherefore panels out of old houses or from old furniture, railway carriages etc. should be treasured. The best wood was and is no doubt mahogany. When other wood is employed, one which is close grained and low in resins must be picked.

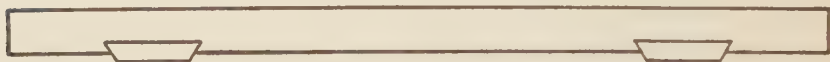
For foundations of large dimension single boards, even when sufficiently wide, should not be used as such. They should be sawed in half and then be glued together. The



weather edge of the one board must always be glued to the heart edge of the other. When a board is sawed through, therefore, the right outer edge is pasted to the right sawed

edge. In turning the one board end for end in the process, the original up surfaces must be kept up. That surface of the board which was nearest the heart of the tree is the one to be painted upon. When several boards of unknown origin are used, all those surfaces originally nearest the heart of the tree must be kept up and the others down.

Larger panels must be cross cleated to allow even contraction and swelling of the wood. The cleats must be cut and set as indicated in the diagram and *not be glued, nailed or*



pegged. While painters will not ordinarily use wood foundations for such large pieces of work, it is interesting to know that areas as large as double doors may be thus constructed and show not a sign of warping, splitting or curling in years.

Wooden panels thus prepared are given a proper painting ground by being coated with wood filler. This is a thin shellac varnish (shellac dissolved in denatured alcohol) into which some white earth has been mixed, like barium sulphate (*blanc fixé*) or silica. After drying, the surface of the board is lightly sandpapered. It is common practice to apply pure shellac over such boards though I hold this to be detrimental. If a non-resinous lumber like mahogany has been used there is little danger of any resins "coming through" the subsequent paintings; and a shellac layer if made thick enough to interfere with such action is likely to crack or chip off or to dry so smooth (even if subsequently roughened with sandpaper) as not to guarantee a good binding with paint laid over it. Moreover, shellac (like any varnish) used anywhere in the building up of a painted surface decreases its

resistance to many of the processes of "cleaning" to which every painting in the course of time is likely to be subjected. Nearly all of them employ an alcohol in some fashion or other which is likely to soften or dissolve the shellac. Not to shellac a board increases its tendency to absorb the oil of oil paints. Many painters wish such an effect. If it is not wanted, more oil may be used while painting or the "dried in" finished picture may be given an extra coat of linseed or other oil (diluted with some turpentine to make sure of good union between the oil coats) ; or it may be varnished.

The metal first used as a foundation for painting was sheet copper. Since then sheet tin, sheet zinc and, in more recent years, sheet aluminium have been suggested. Metals need no preparation beyond a sandpapering of the surface. The roughness thus produced is depended upon to hold the overlaid paint. I have had no experience in painting on metal. Objections to the material seem to be its weight, its limited size, the liability of the paint coat to chip off and the difficulties of restoration so far as the painted surface is concerned, if accidentally bent.

Painting on canvas is almost universal, but offers many handicaps. It has the conveniences of unlimited size, lightness of weight and easy transportability. Linen and cotton canvases are used, of which the former has the better lasting qualities. But even linen is not good for a hundred years.¹

¹ A large fraction of such destruction of the canvas is due to the action of polluted air. Air pollution through "smoke" is not simply a humanly offensive or picture "dirtying" affair—it is a chemical monster which creeps upon the painter's work and literally eats the lining off his canvases. All soft coal carries some sulphur; and a poor grade, as much as three percent. This means that for every ton (2240 pounds) of such coal burned, 67.2 lbs. of sulphur are burned, yielding 134.4 lbs. of sulphur dioxide, which, if water is present in the air, means 172.2 lbs. of sulphurous acid or 205.7 lbs. of sulphuric acid. And a single industrial plant in any major city alone burns several thousand tons of such fuel. Small wonder that our clothes and the artist's canvases "rot!"

The canvases of all the older masters have, therefore, had to be remounted one or more times. If properly performed the procedure can, however, be carried out without harm to a painting.

Some painters cover the raw cotton or linen directly with linseed or some similar oil carrying more or less of some pigment. The oil then soaks into the cloth fibers. The foundation left for painting is agreeable but the total canvas becomes very heavy; and the drenching of the fibers predisposes them to an early decay (either because of the chemical action of some of the ingredients found in the ordinary oils, or the better food materials offered bacteria or other decay-producing life forms by the oil soaked linen or cotton).

To avoid these defects the raw sheeting is usually "sized" with a film impermeable to oil. A freshly prepared thin glue not too thickly applied is most commonly used. Glue sizing has the defect of shrinking and swelling as the air gets dry or moist, thus leading to over-stretching or buckling of the canvas. Should the back of the canvas become wet, there is also danger of detaching the painted film. Glue is, moreover, a food sought after by bacteria and other destructive pests which eat it and so again loosen a painted film. Most of the pigments used in painting have, however, an antiseptic action which works counter to these bad effects.

To overcome the objections of glue, other sizes have been used. Shellac, if thinly applied and if *entirely* covered subsequently by paint, offers some advantages. Unless thinly applied and the texture of the canvas so preserved, the overlaid paint tends to separate off; and unless the surface is entirely covered with paint subsequently, the shellac (like ordinary varnish) is left exposed to the action of alcohol or

similar materials which may later be needed to "clean" a picture. Such treatment, by dissolving the shellac, may loosen an area of oil painting from its canvas bed.

The pigment of choice for surfacing the sized canvas is undoubtedly a lead compound of some sort. A lead paint covers well and uniformly and shows little tendency to crack. It forms, therefore, the best of surfaces upon which to lay further coverings. The reasons for such superiority of lead paint seem to be the following. When, for example, lead white is ground in linseed oil, the lead particles are not merely suspended in the oil. The lead slowly combines with the oil to yield a lead soap. This compound is a tenacious gum-like material which has a good "stretch." A white lead ground in linseed oil yields a paint, therefore, which tends to cover uniformly and without danger of subsequent cracking. Used pure, it may even have too much of this property and so yield too soft or too gummy a ground. The other objection to lead is that if the painter is given to thin painting or to allowing portions of the original ground to remain exposed in his finished work, such exposed portions are affected by smoke-polluted air and turn yellow, gray, or black.

From the chemical point of view zinc oxide is therefore better than lead, but the zinc soap formed after interaction with the linseed oil is a short fibered affair and has therefore a greater tendency to crack, especially if used thick. For these reasons zinc white and lead white are commonly mixed in equal proportions for a ground, the mixture being cut to a proper painting consistency with turpentine.

A good test of the finished ground, whether prepared by the painter or purchased ready-made, is to fold the canvas

sharply, face outward. The paint film should not then be gummy nor yet so crisp as to crack visibly.

In place of zinc white some painters use barium white (barium sulphate) or chalk to mix with the lead white. These materials make the canvas "absorbent"—a property liked by some painters. Both favor cracking. The barium mixture makes a chemically sound ground, but chalk is, in my experience, not to be depended upon. It is affected by the acids of the air with the production of brittle or water-soluble compounds.

Some of the new "permanent" whites have given very satisfactory results. These are mixtures of titanium white with barium white. The former compound being expensive and the latter cheap, it is the tendency of the manufacturer of prepared canvases to use too much barium white which makes again for a quick absorbing but cracking ground.

Most painters wish their grounds toned. If the pure white grounds thus far described are not wanted, gray ones are best produced by mixing the white pigments with the desired quantity of ivory black. Yellow ochre, red ochre and burnt Siena are good for yellow or red toned canvases, but when alizarine tones are used over them, especially when used thin, graying occurs subsequently. It is for this reason that in all pictures where alizarine is to be employed, I always start with white canvases and, when desired, tone these. Such toning may, of course, be done in any color, but the reds, oranges, yellows or greens desired should not be taken from the natural earth pigments (because they contain iron) but from the cadmiums and blues discussed for the permanent palette. I apply the tone by thinning down the requisite pigments with a goodly quantity of raw linseed

oil and turpentine (half and half or even more of the latter) the turpentine serving to "bite" into the painted surface of the canvas, thus assuring good union with the oil which carries the "tone."

XV

THE MEDIA USED IN OIL PAINTING

It has been previously stated that an oil painting consists of colored particles bound together by an oil of some sort. For this purpose a "drying" oil has to be used, and the classical oil is linseed oil. A "drying" oil is not one which really "dries" but one which takes up and combines with the oxygen of the air to form, instead of the original liquid oil, a solid transparent mass. Linseed oil, therefore, "dries" by becoming converted into a new solid compound. This process of taking on oxygen (oxidation) increases the original bulk of the oil, which explains why a painted oil film, originally laid on smooth, will with time show more or less wrinkling, especially if laid on thick.

I think that linseed oil is still the oil of choice. Other drying oils that have been used in painting are perilla oil, poppy seed oil and walnut oil. Some of these are urged upon painters under trade names. The best grades of all these oils are obtained by pressing the ground-up ripe seeds or nuts in the cold. The first fractions of such "cold-pressed" oils are the best. They are permitted to stand and settle. Various impurities thus settle out, the fine arts painter's oil being the clear liquid tapped off the top of the settling vessel. "Raw" linseed oil thus prepared should be the oil painter's sheet anchor. Perilla oil similarly prepared dries faster, as do poppy seed oil and walnut oil. These oils, too, are paler than linseed oil. The first advantages of these oils are sacrificed later,

however, by a too perfect "drying" with a tendency to crack and crumble not inherent in good linseed oil.

The fact that linseed oil is darker than some of the other drying oils induces manufacturers to bleach it. Such bleaching also permits the manufacturer to make marketable what in themselves were second, inferior and darker pressings of linseed oil. The substances used for bleaching are hard to get out of the oil and if not gotten out, may subsequently "bleach" or otherwise affect pigments mixed with them. The fine arts painter should therefore use chemically unbleached oil only.

Sunlight bleaches linseed oil. This explains why paintings stored in the dark get dark but brighten once more when hung in the daylight. The matter is taken advantage of in preparing pale linseed oil. The best quality cold-pressed linseed oil to be used by the painter is simply exposed to the light. Bleaching by such means requires months, which induces the manufacturer to resort to the quicker chemical methods of producing a bleached oil. For the fine arts painter, the oil bleached by light only is the preferable article.

To hasten the drying properties of linseed oil, it is "boiled." If boiled *without* the addition of anything, the resulting oil is known as "stand" oil. This oil is thicker than the original linseed oil (due to an internal "polymerization" of the oil particles) and is really a sort of varnish. It dries no more quickly than ordinary linseed oil and, in the thicker grades, more slowly. What is known as "boiled" linseed oil is this material boiled *with* a metal of some kind (lead, manganese or cobalt usually). Some of the metal remains in the oil and hastens the process of taking up oxygen

from the air, and so the "drying." Such boiled linseed oils are usually darker than the raw, but what is of greater importance to the fine arts painter, if he uses boiled oil, is that the fractions of metal so introduced into his picture affect the color tones just as though he had used pigments containing these elements. Lead changes the hues of alizarine, manganese and cobalt tend to introduce a gray, etc.

What has here been said against the use of "boiled" linseed oil is true also if a "drier" or "siccative" is added to the raw linseed oil used in painting. Such driers are almost without exception salts of lead, manganese or cobalt, or the several mixed, and these ground or dissolved in linseed oil, turpentine or like materials. A few drops of such a mixture added to raw linseed oil will reduce its drying time from three or four days to as many hours. It is a great temptation to use such materials when oil sketching or when enthusiasm makes the painter wish one color sheet to become sufficiently "tacky" to allow the laying of a second over it. The thing can not be done without hazard. In studio work, time and sunlight had best be depended upon; while for sketching purposes, cobalt, manganese or lead driers, though all efficient, are chemically increasingly dangerous in the order named. It must, finally, be remembered that besides tending to darken the oils used in painting and their possible chemical reaction with the pigments used, the driers in the end work too well, leading to too brittle an oil film with its increased tendency to crack and crumble.

The painter can help himself to quicker drying effects by remembering that some of his pigments produce the same action (even though much less quickly) as do the driers which he adds to his oil cup. As every painter knows,

some of his pigments dry faster than others. The cobalt blues (cobalt oxides) for example, dry faster than the ultramarines. All the earth colors (iron oxides) are fair driers. Zinc white is a fair dryer though a poor one when compared with lead white. The cadmiums (cadmium sulphides) actually delay the normal drying time of a linseed oil. Where circumstances permit, one pigment in preference to another may therefore be selected to shorten the periods between the laying on of successive coats. The drying of oil is an oxidation and this oxidation is hastened by some materials and slowed by others. It is a good rule to remember that all oxides hasten drying; all sulphides delay it.

Both to obtain a quicker drying pigment mixture or for subsequent surfacing of the finished picture, *varnish* is used. For our purposes it is well to distinguish between *oil* varnishes and *spirit* varnishes.

Spirit varnishes (or lacquers) are simply resins of various sorts (dammar, mastic, copal, amber) dissolved in alcohol. When painted over a surface, such varnishes "dry" through loss of the alcohol by evaporation. What is left behind is a sheet of the resin or resins used to make the varnish. These sheets are brittle so that the advantage of obtaining a quickly drying surface (or a quickly drying pigment coat if the varnish has been mixed with a pigment) is shortly offset by cracking and crumbling. Spirit varnishes should therefore be avoided either in admixture with pigments to hasten their drying, or applied pure in order to obtain a dry surface upon which to lay a second coat of paint. They vary the chemistry of the binder in the successive coats of an oil painting, tend to crack, and if cleaning or restoration of the finished

painting is subsequently necessary, the materials used in this process are likely to dissolve the varnish sheets and so destroy the whole painting.

The oil varnishes are made by dissolving resins in oils of various sorts, varying from the thin oil or spirit of turpentine to the thicker linseed oil. Turpentine, too, is so volatile that varnishes prepared with it are subject to the same objections as the spirit varnishes. When heavier oils are used, they tend to reduce the brittleness of the varnish film when it has finally dried, which fact makes the use of oil varnishes (even though somewhat darker than the pale spirit varnishes) the technique of choice.

In cheap varnishes ordinary "rosin" (colophony) is dissolved in an oil of some sort. Better resins (like copal, dammar, mastic and amber) are similarly dissolved in oil to produce the fine arts types of varnishes. The oil used has usually been "boiled" or treated with a drier, and either before being sold or as used by the artist, these varnishes are further thinned by the addition of turpentine or what is not so good, a petroleum distillate ("benzine").

It will be noted, therefore, that the oil varnishes, except for their content of resins, are essentially heated oils (like "stand" oils) or, when driers are employed, identical with the so-called "boiled" oils. The exact composition of a manufacturer's varnish is, however, rarely disclosed. Which type should the painter use?

The objections to spirit varnishes have already been pointed out. Those to the oil varnishes are dependent upon the kinds of resins employed, the nature of the oil used and the drier. Dammar resin varnish is very pale but brittle after drying. Mastic is likely to be darker but less brittle

after drying. Copal is a slower drier of yellow tint but very resistant to atmospheric conditions. It does not crack easily. Neither does (true) amber varnish, but this is likely to be rather dark. If linseed oil is the one used by an artist then, in order to keep chemical uniformity between the different oil sheets of a painting, the varnishes prepared from linseed oil should be used, though the driers employed in this oil are all objectionable.¹ Varnishes, moreover, are soluble in materials like alcohol in which "dried" linseed oil is not soluble. This fact, which is used to advantage for the removal of varnish films applied as a final coat *over* oil paintings, is obviously dangerous when varnish has been employed *in* the painting of a picture.

For such reasons varnish should never be used in the painting of a picture. If speed of drying is demanded, addition of a drier is infinitely better. When speed is not necessary, linseed oil only should be the medium of choice. If too thick, it may be diluted with more or less spirit of turpentine. This should be the old, steam distilled oil of turpentine; and not the turpentine distilled from wood. The use of turpentine is good not only because it dilutes the oil and evaporates rapidly afterwards to leave the pure oil behind, but it "bites" into a previously laid-on coat of paint or the ground of the painting foundation, thus assuring good union between the successively laid-on paint films. If the pigments have been ground in nothing but linseed oil and if only linseed oil is used while painting (thinned, if desired, with turpentine), the entire thickness of a picture is then built up of exactly the same chemical body, which reduces to a minimum the chances of unequal volume changes with

¹ See the paragraphs on driers on p. 69.

the coincident wrinkling, cracking or spreading of the paint films. Linseed oil literally "breathes" in the process of drying. It takes up oxygen from the air which increases its bulk some twenty percent, to lose a considerable fraction of this increase later, as carbonic acid and certain other volatile compounds are given off. When oils of different "drying" capacities are used, these figures are much different and so volume changes in the different paint films are more marked with proportionately greater tendencies for distortion.

While the oil painter should not use more oil than is necessary to accomplish his ends, he should *not use less*. It is the oil which is depended upon to hold the pigment particles together and too little oil will permit them to fall apart or to rub off. Too much oil, on the other hand, merely reduces the brightness of a picture through the color inherent in the oil.

When a picture is completed it needs protection against the atmosphere especially in smoke and dirt-polluted, industrial centers. One way to accomplish this is to cover the painting with glass. Even the clearest glass subtracts something from the color values of a painting and the atmosphere still manages to work around the edges of a glass and through the back of a painting even when sealed with paper. For this reason it has always seemed best to me to cover the finished painting with a film which may be washed with soap and water. Varnish is most commonly used. If the records of the old masters are complete, they used straight linseed oil, or a boiled linseed oil, to which *no* drier had been added. This is the so-called "stand" oil. I have availed myself of both these materials in place of varnish and with good results.

The face of the finished and thoroughly dried canvas is first washed with good soap and luke-warm water,¹ then carefully but thoroughly rinsed to get rid of all soap, and set aside for a day or two to dry. If the canvas can then be exposed to sunlight for an hour or two (sunlight through a window is too low in ultraviolet light to be best, but burning, direct sunlight is too much) it is ready for the final coat. I dilute a good linseed oil or a stand oil with one third or even one half of turpentine and paint this on carefully, laying the picture flat in a clean room to dry. These final oil coats will not dry in less than two to four days.

In the line of varnishes, all of the spirit varnishes which I have used for the final coat over an oil painting have crumbled, gone flat, or turned dirty within three to five years. I no longer use them. The only advantage they have is that they can be easily removed and replaced by something better. The two best varnishes of the oil type that I have found are commercial ones not offered the fine arts painter as of especially high grade. The one is a light-colored American spar varnish and the other a German "boiled linseed oil varnish free from lead," and resins. The second is of lighter color, has remained clear and has shown no reaction to moisture, temperature changes, air-pollution or an annual soap and water wash of its unglassed surface.

¹ The soap should be "neutral" wherefore a good shaving soap is to be employed. The water must be merely warm and a little water with much soap should be used in the washing process. With too much water the wash water becomes alkaline and will then affect even a dried linseed oil as well as bleach or wash off alizarine and similar tones. The soap must subsequently be *entirely* removed by *quick* rinsing with *much* clear water.

XVI

THE PALETTES OF THE MASTERS

Today's novitiate in painting, whether he is the product of an "academy" or (better) of a master, is usually handed ready-made not only his painting ground but his media and his palette. Ask any producing artist why he is painting with the materials that he carries in his kit and his answer is that a "teacher" wrote him a list, subsequently modified, perhaps, because of the claims of some advertisement or a pigment agent.

To appraise the value of such teaching, two schemes are open—the student may compare what he is doing with the technique of masters of which history has given us an inkling, or he may make record of how those work who live about him today, leaving it for a new generation to decipher what a quarter or half century may have done to such methods.

Strangely enough, any kind of printed record of how the oldest masters worked and one really intelligible to the painter of today hardly exists. Let those who think otherwise try the texts of THEOPHILUS PRESBYTER, CENNINO CENNINI, or VASARI. These men taught their pupils, their pupils learned well, "schools" came into being—and passed, with no historic record left behind save that of their artistic productions themselves. Why this should be the case is not easily answered. It may have depended upon the fact that what is today a "fine art" was then essentially a craft, and to have

learned to do a thing well was not at once synonymous with a right to publish such truth to the world. Or, men skilled with the brush may, as today, have feared the use of the pen.

We know from the VAN EYCKS and the early Italians that they used a series of naturally colored minerals and that they painted with sunned linseed oil. For tempera and water color they used the same pigments but a "glue" instead of an oil for the binder, the composition of the "glue," however, remaining a mystery. One such glue was like the material we use today (the hot decoction of the cartilages and skins of sheep and other animals), but oftener it was egg white or egg yolk, or milk; or gum arabic, or the gum or juice (the "milk") of some other plant or fruit.

The nature of such water color painting would not concern us did the evidence ¹ of the last half century or more not render it increasingly probable that some at least if not all the first *oil* painters (including the VAN EYCKS!) "laid in" their pictures in such water color, to paint over them subsequently when dry, with varnishes and oils, either pure or tinted to give "glaze" effects. The total chemistry involved in such a transformation is large; the process is capable of yielding ultimate results, both as to type of picture painted and what becomes of it in time, which are not easily covered in any short essay. This much, however, may be sufficiently simple to give any painter following this oldest "oil painting" technique an understanding of why he gets the results which he does.

To give a maximum of "brilliancy" to their oil produc-

¹ See, for example, the articles on the history of oil painting by ERNST BERGER: *Beiträge zur Entwicklungsgeschichte der Maltechnik*, I, II, III, und IV, München (1901-1912); Böcklins *Technik*, München (1906); A. P. LAURIE: *The Painter's Methods and Materials*, Philadelphia (1926).

tions, the old masters painted "thin" upon a white background. The white background was almost universally one of wood painted over with chalk held together by some variety of "glue" binder and then rubbed smooth. At times, plaster of Paris was used. In either case a white "gesso" background was obtained. Such a ground not only took up water color (tempera) rapidly but drying soon occurred. Their tempera pigments being miscible with water, finer gradations in color could be obtained than with oil colors directly, and water color painting lent itself to more rapid painting of large surfaces. The reflected light from the white underpainting then gave a peculiar brilliancy to the colored pigments brushed thinly over it. Once the water had dried out, a varnish or any oil could be painted over the (original) water color, and the varnish or oil now acting as a binder for the pigment granules, the total picture was transformed into an "oil painting." Into this or over it, pigments ground from the first in oil could then be painted as the artist desired.

Such transformation of a "water color" into an "oil color" became a little more complicated when the so-called "oil tempera" was employed. To start with, this, also, was a "water color" (tempera). The pigment, as in the original tempera, was again mixed into a binder that might be diluted with *water* (egg yolk, egg white, casein, parchment glue, plant "gums") but *into* this binder there had been "emulsified" a certain percentage of oil or varnish. Technically expressed, the binder was an oil-in-water emulsion (like ordinary milk) carrying the pigment, and because of this type of emulsion, the prepared "paint" mixed readily with water. Once, however, this "oil tempera" had been

painted upon a ground and allowed to "dry," the water-in-oil emulsion changed to one of oil-in-water (comparable to butter) and this would then no longer mix with water but would mix with oil.¹

By such method does the modern tempera or oil tempera painter also begin with a "watercolor" production which ends as an "oil painting." A whole school of such tempera-oil painters flourished in Munich after the middle of the last century, of whom BÖCKLIN was the most original if not the greatest example.

The early Dutch and Italian painters used a lead white for their white. Even though they mixed at least one sulphide color with it (vermilion, which is mercury sulphide), little darkening (graying) seems to have occurred. The reason for this may be twofold. The vermilion was a *natural* cinnabar, a material therefore in which the red grains were partially, at least, encased in a glass-like material (silica) so that chemical interaction with the lead was avoided. Today's vermilion, produced chemically, is devoid of such protective housing. Second, Italy is not covered with a smoke-laden (sulphide containing) atmosphere. The Dutch masters found in northern Europe are certainly less brilliant than their Italian contemporaries; and Italian primitives, moved to industrialized countries north and west, have suffered for the change.

The remaining pigments of the old masters were all colored earths or natural minerals. Yellow earth (yellow ochre), red earth (red ochre), purple earth (violet ochre),

¹ For a scientific discussion of such emulsions and of the properties of the "emulsifying agents" (the varying characteristics of which are responsible for all the debate concerning the relative merits of those employed in the production of tempera paints) see MARTIN H. FISCHER and MARIAN O. HOOKER: *Fats and Fatty Degeneration*, New York (1916).

green earth (green ochre), were their standbys, and whether they came from Siena or Pozzuoli or Vesuvius or Bohemia, all of them were materials which geologic ages had reduced to chemical deadness and therefore permanence. To these they added black made by charring ivory, bone or certain woods, thus obtaining a pure carbon (save for some harmless ash accompanying it) which in this form was again the most inert of chemical elements. Ultramarine was the universal blue and because "natural," from lapis lazuli, was literally housed in (transparent) rock, and so protected from any external chemical action. Azurite, a native copper carbonate (the *azzurro della magna* of the Italians) was also employed, owing its permanence as a blue also to the fact that it was housed in native "stone." After 1700, smalt came into use which, being a finely powdered cobalt glass, was similarly permanent.

Some of the other minerals employed may have fared less well, though none now to be mentioned seems ever to have been used in large amount by the first masters. Minium (an oxide of lead), when used instead of vermilion, may have grayed in the course of years (though no more than the lead whites). The less brilliant litharge (another oxide of lead) probably never made much headway against the better red ochres. About *giallolino*, now translated into Naples yellow, there is some debate. When it was a pale yellow ochre, more yellow than the ordinary, it was as permanent as the rest of the ochres. If it was lead antimonate, as generally believed, then it was permanent if not touched by metallic iron. The Naples yellow in TURNER'S sunsets has gone gray because handled with a palette knife. Where *realgar* (the red or orange disulphide of arsenic, As_2S_2)

or orpiment, also known as auripigment (the yellow trisulphide of arsenic, As_2S_3) was used by the older painters, unlooked-for dark or black patches have developed in their masterpieces.

XVII

THE MUNICH PALETTE

I know of no better way of stating the problem that faces today's painter than by referring to what is probably the most conscientious effort that has been made in our times to solve it. The Munich Society for the Advancement of Rational Painting Technique, consisting of a group of painters with whom a group of manufacturers who feel a sense of responsibility for the productions of their artist clientele has made common cause, has sponsored a list of pigments which they adjudge to be "absolutely safe" or "indispensable." It should be studied carefully. Perhaps no painter would at any one time care for the complete list, either because not needed or because several of the pigments are of practically identical color value, but the list should be studied in its entirety nevertheless. It is as follows, though the order in which it is reproduced is my own for purposes of easier discussion:

- | | |
|--------------------------------|--|
| 1. Ultramarine blue | (sulphur subdivided in a "glass" matrix) |
| 2. Cobalt blue | (an oxide of cobalt with an aluminium earth) |
| 3. Paris blue | (iron ferrocyanide, Prussian blue) |
| 4. Cobalt green | (an oxide of cobalt with a zinc earth) |
| 5. Chromium oxide, dull | (an oxide of chromium) |
| 6. Chromium oxide, transparent | (an oxide of chromium) |
| 7. Chremnitz white | (lead white) |

- | | |
|--|---|
| 8. Zinc white | (zinc white) |
| 9. Naples yellow, light and dark | (lead antimonate) |
| 10. Cadmium yellow, light, dark and orange | (cadmium sulphide) |
| 11. Indian yellow | (magnesium xanthate—but now frequently an aniline lake) |
| 12. Vermilion | (sulphide of mercury) |
| 13. Alizarine, red or dark violet | (a complex organic compound derived from anthracene and precipitated with an aluminium earth) |
| 14. Light ochre, gold ochre, dark ochre | (an iron oxide or hydroxide bearing earth) |
| 15. Terra Siena, raw or burnt | (an iron oxide or hydroxide bearing earth) |
| 16. Iron oxides (English red, etc.) | (iron oxide) |
| 17. Red ochre (terra Pozzuoli) | (an iron oxide bearing earth) |
| 18. Terra verde, red or burnt (Bohemian or Veronese) | (an iron oxide bearing earth containing iron silicate when green and unburnt) |
| 19. Umber, raw or burnt | (an iron oxide or hydroxide bearing earth containing some manganese) |
| 20. Ivory black, vine black | (carbon with ash) |
| 21. Graphite | (carbon) |

Let us take it for granted that the pigment furnished by any given manufacturer is really that indicated by the label and that no sophistication of any kind has been indulged in. (There are plenty of pale cadmiums sold that never met cadmium, and plenty of Indian yellows that never saw India; and even the humble wash blueing, which is Paris blue, has by strange alchemy, frequently come out of aniline vats.)

Nothing is to be said against numbers 14 to 19 inclusive in this list. They are all "earths," and chemically nothing but oxides or hydroxides of iron with more or less silicate or

manganese mixed into some of them to explain their particular shade. They are incapable of reacting chemically with each other and are therefore, if used by themselves, absolutely permanent. Numbers 20 and 21 may be added (elemental carbon) without fear, provided the "burning" of the ivory or bone (to yield ivory black) or the wood (to yield vine black) has been followed by thorough washing of the pigment to free it from bituminous substances. Graphite black is a still safer black if its quality as a paint is deemed satisfactory. For white, 8 should be chosen at least for surface painting because least affected by a smoke polluted atmosphere, and 7 be discarded because of its lead content. If 7 is used for underpainting, its surface must be *completely* covered by some subsequent coat, else the exposed white will yellow or gray in the course of time. For blue, 2 should be chosen (if sufficiently deep) as this is essentially an oxide of cobalt and therefore incapable of reacting with any of the materials thus far listed. To heighten the greens, 5 and 6 may both be used which, again because they are both oxides, will keep the total palette chemically dead.

If with the palette as thus far arranged sufficiently "brilliant" effects cannot be obtained, it is well, in my opinion, not to add to this list but to start over again.

Of the three blues available, Paris blue (3) is least to be commended. It is iron ferrocyanide, under suspicion as to its permanence when used alone, and definitely guilty in many mixtures. If employed for the greenish cast of its blue, this may be obtained more safely by mixing a bit of yellow into either of the other two blues [preferably cadmium yellow into ultramarine, because both "sulphur" colors; or zinc

yellow, strontium yellow or barium yellow (not in this approved list) into cobalt blue, because a chromate will not react with an oxide]. If cobalt blue has been chosen as the blue, cobalt green (4) and the two chromium oxides (5 and 6) may be added without danger, and either of the whites, with the restrictions already laid down. For the yellow to red range, the cadmiums (10) and vermilion are probably safe, question in the matter arising from the fact that these are all sulphide pigments which, if they should react with cobalt, will lead to darkening. For this reason zinc chromate (zinc yellow), strontium chromate (strontium yellow), or barium chromate (lemon yellow), none of which is in the Munich list, would be better choices for the yellow; and an oxide red (red ochre) for the red, if adequate for the artist's purposes. To this list any or all of numbers 14 to 21 may now be added.

If the total palette has now again sunk to too low a key, a third start may be made. This time ultramarine is chosen as the blue. Being a "sulphur" blue, zinc white becomes the white of choice and the cadmiums (10) and vermilion (12) may be added without danger. Cadmium red (a sulphide and selenide of cadmium), which is not in the Munich list, may well be substituted for the vermilion if adequate to the painter's needs. Either or both of the chromium greens (5 and 6) may now be added, though if high keyed painting is desired it is well not to go beyond this list. Numbers 14 to 21 are generally considered safe additions, though some hold that darkening is possible, especially if the cadmiums have not been thoroughly "washed" free of soluble sulphides, thus making possible the formation of some iron sulphide (which is black).

It will be noted that no mention and no use have been made thus far of Naples yellow (9), Indian yellow (11), or alizarine (13). These are the tricky pigments in the total list and their presence explains why the Munich palette series is referred to as absolutely permanent "or indispensable." The three are not permanent and their admission is made only upon the secondary ground of being indispensable. Why are they defined as indispensable, and if indispensable, how are they best used?

It seems to me that Naples yellow might well be omitted. Good grades of yellow ochre have the same color value and are permanent. If such an iron pigment cannot be used, then one of the cadmiums (or barium, zinc or strontium yellow) might better be reduced through white and black or blue to the tonal values of Naples yellow. Indian yellow (essentially magnesium xanthate) is wanted for its transparency and for glazing. It is a dearly bought yellow for which a good cadmium (or even zinc or strontium) yellow might make at least partial substitution.

For alizarine crimson (13) there is no substitute. No mineral red has its qualities, and the rosy tints of morning and evening skies and flowers are alizarine. It is *not* permanent to light but the best in its class. The synthetic material is better than the natural (rose madder) because the latter contains from the first more or less "purpurin" which, while chemically closely related to alizarine crimson, is *more* light sensitive. It is for this reason that the bluer strains of the synthetic alizarine (violet alizarine) should be avoided, such violet shades being better obtained by mixing the alizarine crimson with ultramarine. But alizarine is also sensitive to all iron salts and many oxidizing

agents. Numbers 14 to 19 should therefore *not* be mixed with it nor 5 and 6. On the other hand, reducing agents tend to preserve the color of alizarine, wherefore ultramarine, the cadmiums (including cadmium red) and vermilion with zinc white (and any black desired) become the safe adjuncts to this probably most brilliant palette now available.

As obvious from this discussion, the twenty-one members of the total Munich palette (many of the members have two or three subheads) can *not* be mixed into each other willy-nilly if permanent effects are desired. It has been indicated how at least three satisfactory palettes which will stand up may be derived from the total list. When any one of these by itself proves inadequate to the task in hand, what may be done? The answer is found by painting in mosaic-like fashion, laying the enemy pigments side by side but never mixing them. Suppose a luminous greenish blue sky is to be painted against a deep purple tree trunk. Transparent chromium oxide with zinc white is wanted for the first, and alizarine crimson and ultramarine for the second. The alizarine crimson may not be mixed with the chromium oxide, but each of the mixtures may be made by itself and then be laid side by side with safety.

But even the shortened palettes here discussed go far beyond the needs of the thoughtful painter, and far beyond what the masters had (or used) in the production of those works of art which still serve as patterns for the moderns. The artificial ultramarine we use today did not come into being until about 1828, and the chromium oxide greens (now regarded as indispensable for the painting of foliage) were not known until 1836. The cadmium series from yel-

low to orange was discovered in 1817 and cadmium red is only a few years old.

According to SIMMONS,¹ VELASQUEZ' palette consisted of nothing but red, yellow, black and white. It might not be out of the way to suggest to the modern novitiate in oil painting, for trial at least, a return to this simple set-up (say, vermilion, pale cadmium yellow, ivory black and zinc white) just to discover for himself how far it will carry him.

Note the effects produced with five pigments in Plate III.

TITIAN'S "Christ Crowned with Thorns" is painted with four pigments, and RUBENS' is said never to have gone beyond seven.² Compare with the lasting messages of these masters the already distorted ones of the French school of the last century. GÉRICULT'S palette carried fifteen pigments; INGRES', seventeen; and DAVID'S, eighteen.³ I have been told that ZORN did his first oil paintings (in the early nineties of the last century) with nothing but vermilion, yellow ochre, ultramarine and white. He probably broadened this palette later, adding a brighter yellow, and he seems to have added (to his disaster) madder or alizarine, for the once pearly shadows in the white silk dress of his portrait of Mrs. Potter Palmer are now a dirty gray.

FRANK DUVEINECK (as told me by MARTIN RETTIG) when a student in Munich, used the palette of its traditional school (not the tempera-oil one referred to in the preceding paragraphs nor that of the Munich Society). This meant bitumen for the black in the earliest years (1877-81) with all its consequent darkening, bleeding, crawling

¹ EDWARD SIMMONS: *From Seven to Seventy*, 152, New York (1922).

² MARY HAMILTON SWINDLER: *Ancient Painting*, 203, New Haven (1929).

³ CHARLES MOREAU-VAUTHIER: *The Technique of Painting*, 50, London (1912).

Plate III

"Portrait of C.", by JOHN E. WEIS. The reproduction illustrates the wide effects that may be produced with an exceedingly simple palette. Permanent blue (*ultramarine*) appears in the background. The rest of the picture is painted with white, black, zinc yellow, Venetian red and burnt Siena.



Plate III

and slipping, for it is an oil-soluble pigment and never dries. Later bone brown took its place, again in the effort to get "warm" grays, but since the warm tones of bone brown and all related "earths" are also the product of the bitumen-like substances still contained in them, the ultimate effects were again bad,¹ though not as bad as when pure bitumen was used. In his later years (I have it from his pupil JOHN E. WEIS) DUVERNECK'S palette carried the following: yellow ochre, raw Siena, transparent gold ochre, burnt Siena, Venetian red, Chinese vermilion, terra verde, ultramarine and ivory black. Nothing can be said against this palette. He was so in the habit of using burnt Siena for his shadows that his pupils dubbed it "DUVERNECK blue." He would himself employ alizarine at times, but he forbade it to his pupils saying that "they did not know how to use it." Mixed with the iron earths, which made up most of his palette, it was, of course, doomed to destruction.

¹ See page 45.

XVIII

THE PALETTES OF SOME MODERNS

Of modern oil painters I quote the following as the palette of SIR ALFRED EAST: ¹ flake white, yellow ochre, pale cadmium, middle cadmium, deep cadmium, rose madder, burnt Siena, Venetian red, raw umber, cobalt, French blue, viridian, ivory black with vermilion used as a substitute for madder. Sir ALFRED can justify the use of a lead white by pointing to the old masters. With vermilion used in place of rose madder, the entire palette is safe, but with the rose madder in its given place there is danger, doubly so because he uses the natural alizarine which will not endure mixture with the several ochres and especially not with viridian (transparent oxide of chromium). The peril would still be negligible if Sir ALFRED used the several pigments in "mosaic" fashion, but he recommends for skies (with freedom as to mixture, apparently) "white, yellow ochre, cobalt or French ultramarine, viridian, rose madder or Venetian red with a touch of raw umber." The rose madder is not safely mixed with the yellow ochre, the viridian, the Venetian red or the raw umber. For skies he "uses": "white, yellow ochre, French blue, middle cadmium, transparent oxide of chromium (viridian), rose madder" and "sometimes a warm gray of raw umber and white." Safe mixture is possible in this instance only when another red is found for the rose madder.

¹ ALFRED EAST: *The Art of Landscape Painting in Oil Colour*, 10, 68, 76, London (1906).

JOHN F. CARLSON¹ recommends the following:

1. Light yellow, a choice of spectrum, strontium, lemon, *cadmium light*.
2. Medium yellow, a choice of Mars medium, *cadmium medium*, chrome medium.
3. Dark yellow, a choice of transparent gold ochre, *Mars yellow*, raw Siena.
4. Brilliant red, a choice of *cadmium red*, spectrum, *vermilion*.
5. Medium red, a choice of terra rossa, light red, *Indian red*.
6. Dark red, a choice of madder deep, rose madder, *alizarine crimson*.
7. Red brown, a choice of burnt Siena, *Mars deep*.
8. Green, a choice of viridian, *emeraude*, permanent green deep.
9. Blue, a choice of cobalt, permanent blue, *ultramarine* (all of violet hue).
10. Blue, a choice of Prussian, Antwerp (all of green hue).
11. Black, a choice of *ivory black*, lamp black.
12. White, a choice of lead or *zinc white*.

He himself uses "but nine colors," but does not say which; and adds that "if lead white is used, avoid using vermilion and cadmium yellows."

In comment on this table the following should be noted. Free choice in the various rubrics and indiscriminate mixture of the various pigments can *not* be made with safety so far as permanent results are concerned. The "spectrum" yellow and red are probably "lakes" of questionable

¹ JOHN F. CARLSON: *Elementary Principles of Landscape Painting*, 224, Mountain Lake Park (1929).

endurance. The chrome yellow of 2 is thoroughly bad. The three reds under 5 are chemically identical. Alizarine, the chemically purer red of 6, is to be preferred to the "natural" madders. 8 gives three different names to the same thing (chromium oxide) if the manufacturer is honest. In 9, permanent blue is just another name for ultramarine; and in 10, Antwerp blue is identical with Prussian (unless "cut" to a lighter tone by admixture of some sort). Under 11, the lamp black is the more likely to carry "tar" if improperly washed. This leaves as the first choice, in my opinion, those that I have italicized, with the usual care to be exercised in the use of the alizarine that has been noted before.

WILSON IRVINE writes me that his palette, both for oil and water color painting, carries the following: alizarine crimson, cadmium red, cadmium orange, cadmium pale, vert emeraude, cobalt blue, permanent blue. The choice here carries the sign of chemical knowledge. If alizarine crimson is not mixed with vert emeraude, the total series is incapable of chemical reaction. Permanent blue is the better blue to mix with the cadmiums, and cobalt with the vert emeraude. IRVINE paints on linen canvas covered with white lead and (apparently) uses white lead for mixture with his colored pigments. He does *not* thin his prepared pigments (thus avoiding the excessive use of oil which yellows with time, and darkens) and uses *no* driers. To cover his finished paintings he uses a "very little" mastic varnish.

WALTER L. PALMER'S palette is set as follows: zinc white, cadmium yellow, yellow ochre, raw Siena, vermilion, madder lake, cobalt violet, terra verde, viridian, cerulean blue, cobalt blue, raw umber, van Dyke brown. The same pig-

ments are used both for his oil paintings and his water colors. The van Dyke brown carries oil-soluble materials of the bitumen class. Alizarine might be substituted for madder lake in the interests of greater permanence, provided the madder lake was really derived from the madder root in the first place. It should not be mixed with cobalt violet or viridian (which oxidize it) or the earth colors (because of the iron they contain). With madder lake omitted, the rest of the series might safely be mixed in any fashion desired, question arising only in the instance of van Dyke brown (on its own account). Linseed oil and turpentine are used for thinning with "very little" siccatisf de Courtrai or siccatisf de Haarlem. The siccatisf de Courtrai carries lead and manganese compounds into the picture with the dangers of too great "drying" of the linseed oil and subsequent darkening and cracking. The less effective siccatisf de Haarlem with its resin is at least safer. After a year or more, PALMER varnishes with copal or mastic.

JOHN E. WEIS lists the following pigments for his oil painting and water color: alizarine crimson, burnt Siena, yellow ochre, four cadmiums (red, orange, middle, and light), zinc white, cobalt blue, permanent blue, vert emeraude and ivory black. He avoids mixture of alizarine crimson and vert emeraude, uses raw linseed oil with turpentine as a diluent and a little siccatisf de Haarlem for painting outside his studio. A commercial spar varnish thinned with turpentine is used over his finished paintings. The original of Plate III was executed with a shortened set of these pigments, zinc yellow having been used instead of a light cadmium.

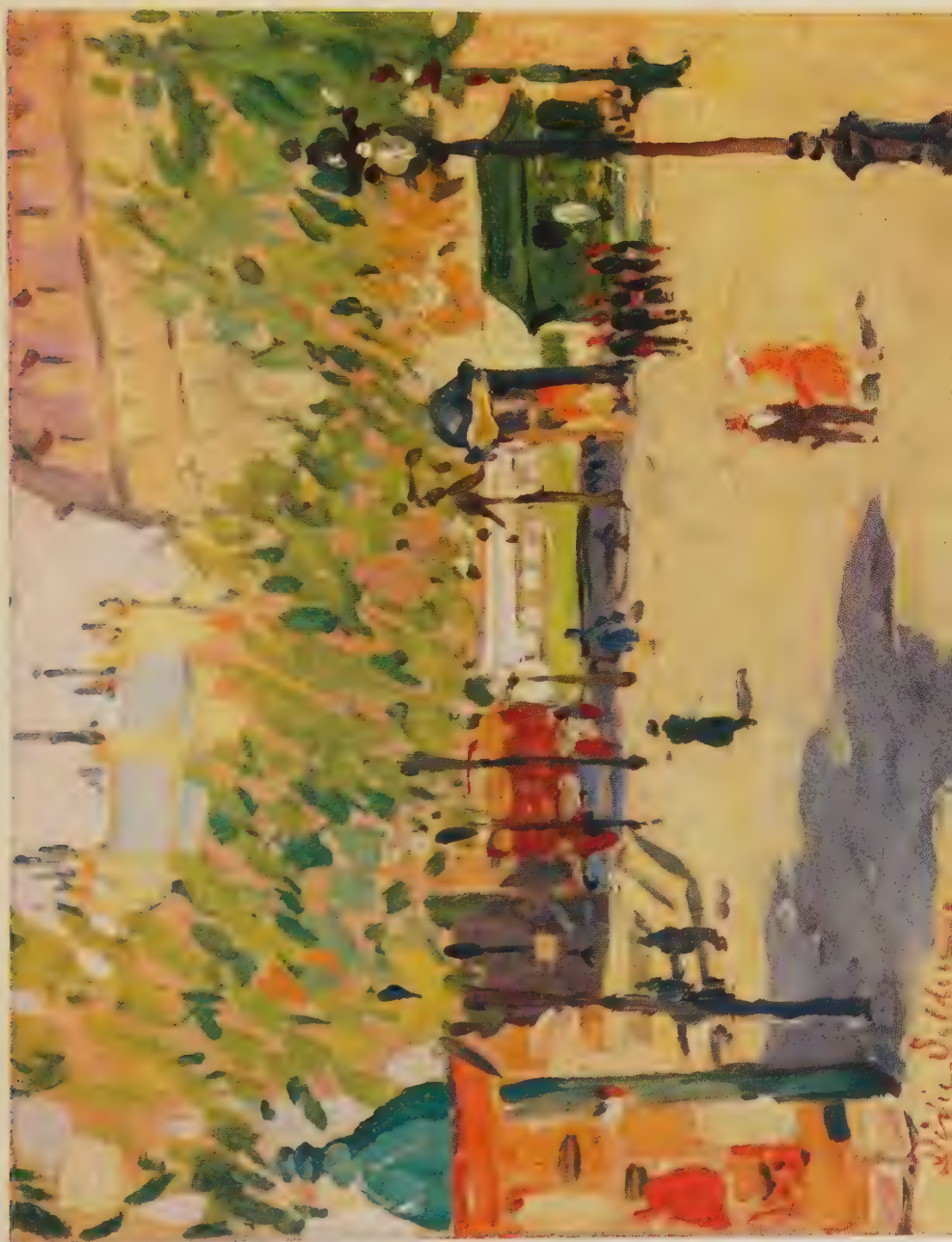
DIXIE SELDEN, whose high keyed paintings have kept

their color in undiminished intensity, paints on white canvas first toned by rubbing over it, with a rag, a mixture of alizarine crimson and ultramarine, well thinned with turpentine. For diluting her pigments she employs a mixture of raw linseed oil and turpentine half and half. No drier is used in studio work. For sketching out of doors, she employs a "touch" of siccatis de Courtrai. Her palette carries the following: zinc white, light, middle and orange cadmium, orange vermilion, alizarine crimson, viridian, ultramarine. Only in portrait work does she use ivory black (for textiles, hair etc.), and viridian is never mixed with alizarine. She employs no earth colors. She *never repaints*, so that her whole canvas remains a "mosaic." When completely dry, she covers her canvases with a mastic varnish thinned half, or even more, with turpentine. What may be accomplished in this fashion is evidenced in the original of Plate IV.

A "constant experimenter," PAUL DOUGHERTY, reports the following regarding his technique (January 1930). This history should be of great use to a generation of painters to come. Twenty years ago, he used egg-tempera (in other words, an oil-tempera) for underpainting, a scheme since abandoned as "unflexible and unsuited to modern expression." But he is again interested in an "emulsion" which he thinks has "none of the drawbacks" of his older tempera. As this is the method followed by the first oil painting masters, the future of these canvases should be particularly studied. Some of his smaller productions (up to 20 by 24 inches) are painted on a composition wood board "covered with a light coat of white lead" (without any previous filling, priming or shellacking?). For thin-

Plate IV

“Paris” by DIXIE SELDEN. To illustrate the high-keyed effects obtainable with a well chosen simple palette.



St. John's, N.S.

ning his pigments, he employs the finest turpentine or petroleum. No drier is used. In some of his older pictures he used copal or mastic varnish diluted with turpentine. He delays the use of any varnish over his finished productions as long as possible; has employed a spirit varnish on some of them, but prefers to have his canvases go out of his possession unvarnished. His palette carries the following: yellow ochre, Mars yellow, cadmium yellow, (pale and orange), Mars orange, burnt Siena, Venetian red, cadmium red, madder lake, viridian, cerulean blue, ultramarine, Mars violet, ivory black, burnt umber. Tones carrying the cadmiums or madder are kept away from those carrying iron. Mars orange is used for glazes. He has used both zinc white and flake white, and prefers the latter, "not having found that it darkens" with his pigments. For water color painting he employs a similar series but in addition, cobalt violet, aureolin, alizarine green (a lake, probably).

CHARLES H. DAVIS sets his palette with the following: zinc white, orange, middle and light cadmium, lemon yellow, ultramarine, cobalt blue, English vermilion, light red, vert emeraude. He holds in reserve ivory black, burnt Siena, purple madder and cobalt violet. Note that in his regular palette he uses no madder or alizarine. English vermilion is an *iodide* of mercury (not a sulphide which is the true vermilion) and as non-permanent as it is beautiful. Lemon yellow is barium chromate which may not be mixed with any madder; nor may the purple madder be mixed safely with the burnt Siena or the cobalt violet of his secondary palette. DAVIS avoids the use of black (chemically perfectly safe) because of the quality of the gray produced, does not trust cobalt violet (justly so when a madder is used

with it), and prepares his greens by mixing "blues and yellows, accented by vert emeraude."

The palette of FREDERICK J. WAUGH deserves study because he paints with a titanium white (permalba). He gives no details regarding his methods, but if he does not mix his alizarines with his raw Siena or viridian, he uses one of the best thought out palettes conceivable. It is as follows: titanium white, deep ultramarine, cerulean blue (optional), ivory black, raw Siena, deep alizarine lake, cadmium red, pale, middle and orange cadmium, viridian.

XIX

THE PAINTER'S CAPITAL

The modern fine arts painter is given to buying his wares ready-made and trusting to luck. What he buys is largely dependent upon the statements of a siren-voiced salesman. I am the last to disbelieve that modern science and technique has nothing of value to add to the knowledge of the old masters, but the fact remains that the story of modern commercialism is only a few decades old and it has required centuries to write the history of a reliable painting technique. Only a dealer who mixes his conscience with his trade should therefore be relied upon.

Companies which sell pigments in carload lots have little patience with us who find studio tubes large sized. There are, however, colormen in various parts of the world who still hold more than a merely commercial interest in the quality of what they contribute to the fine arts monuments of their civilizations and these should be encouraged. And should some layman ever be found desirous of a monument, he could build himself none better than by endowing a fine arts laboratory from which bulletins might be issued covering the exact technique and the nature of the materials used by producing masters; in which there might be made available to present day workers, fine arts materials of known quality; and to which there might be brought for study the products of manufacturers who have something different and better. A quarter of a century of such coöperation between

master and colorman would serve to prove the truth or falsity of any scheme of manufacture, of any man's chemical theories and of salesmanship.

For my own part, I have found it pleasurable (not to say profitable) to accumulate and study my own pigments, oils and varnishes as opportunity has presented itself. I buy nothing that bears a secret or unfamiliar name. If I cannot believe a manufacturer's label or his analyses, I analyze the material myself or forego it. Chemically reliable pigments can be purchased dry and ground by the painter himself in a porcelain mortar with linseed oil that he has obtained from a reliable color salesman or oil distributor. Pigments ground in pure linseed oil and *nothing else* make the most enduring ready-mixed paints. In buying tube paints I try to obtain only such. To improve the texture of ready-made paints, manufacturers are given to the use of other oils in addition to linseed, to the addition of petroleum distillates, resins and beeswax—all of them contributions which, in the long run, carry within themselves dangerous possibilities. Ageing helps paint mixtures, so that ground in a minimum of oil and kept in tightly sealed cans or tubes, one has good material always on hand. For studio work, I buy the purest grades of zinc white ground in pure linseed oil in the well-sealed cans supplied house painters. Here age again helps to a union between the zinc white and the oil (with the formation of zinc soap) which improves the cohesiveness and the "pull" of the ready-to-use paint. All this is still more true of lead white.

My linseed oil I buy in gallon lots whenever opportunity offers. I make a friend of a dealer in oils and through him secure pale (unbleached) first pressings obtained "cold." As

the oil stays pale and is further and safely bleached by exposure to sunlight, I keep the oil in glass bottles in the sun. Most of the pale linseed oil sold the artist has been bleached by a sulphuric acid process. When properly carried out, it probably does not injure the oil but a first pressing oil is pale without chemical bleaching and is therefore safer. The containers for such oil must always be well stoppered to prevent access of air which "dries" it.

For quick drying effects when sketching I use cobalt linoleate in preference to other driers. This material may be bought ready-made though I prepare it myself.¹

A palette of the necessary pigments but the fewest possible that will accomplish the painter's end and these picked from a chemically closely related series of elements, the pigments ground in linseed oil and used with this only, upon a turpentine-bitten linseed oil surface, the finished picture covered finally with a film of pure linseed oil, a "stand oil" or a linseed oil varnish—these are the ingredients which in the finished picture spell uniformity of technical construction and chemical deadness. And in these is written the degree of permanence of the painter's message.

¹ Linseed oil contains much linoleic acid. The oil is first made into a potassium soap by boiling the raw linseed oil with caustic potash. When cold, the soap is poured into a solution of cobalt chloride until a precipitate of cobalt linoleate (another soap) no longer falls out. This precipitate is filtered off, washed with water, and dried in a warm place. I then dissolve a little of this material in spirit of turpentine or linseed oil. Two or three drops of such a mixture in the oil cup of the painter is all that is necessary to hasten drying.

XX

CONCLUDING REMARKS

The problem of the modern painter seems to me to be an infinitely more difficult one than that of the older masters. The old master had to be, and his public desired him to be, a realist and only as he wished otherwise did he show himself an idealist. The modern painter must be an idealist. This has been brought about through the change which the last six or seven centuries have wrought in our material world.

What were the subjects of the first painters? Without exception they were religious themes or portraits. The religious pictures were painted primarily as instruction sheets—and as such are straightforward story pictures. It must be remembered that the common people could be taught in no other way, for books, except as manuscripts, were unknown. The portraits served as monuments to the men and women of a period. The non-realistic reproductions of sitters are probably gone and painters who could paint such probably starved. In our day printers and the books printed from movable type have taken the place of these artist instructors; and the photographer's images of men, women and children are infinitely more satisfying to the relatives than those suggestions of them which the portrait painter offers.

Time and pre-eminently our half century have therefore compelled the painter, willy nilly to put something more

than realism into his canvases. It means mood; it also means entrance into the abstract and the ideal.

The matter concerns us in the material aspects of painting. A crucifixion will carry its story on drawing alone. If color is added, it does not matter much if violet goes gray, for black and white are nearly sufficient to tell the entire story anyway. But suppose the artist tries the mood of a wet spring morning, the play of light upon a flower field, or the moral obliqueness rather than the physiognomic constants of a judge. Here the technique and materials of the older masters seem to lack a something which modern chemistry and the pigments of our day seem almost uncannily able to supply.

Some years ago SYDNEY JOSEPH said to me that he thought that Greek sculpture was already decadent when PHIDIAS lived. It surprised me because I was brought up in the belief that there were no marbles surpassing his. JOSEPH explained his view by saying that the Greeks had too complete a control of their medium, that their tools could cut too nearly a replica of the thing they saw in nature. I had forgotten his discussion until a little while later when I spent a morning before the Assyrian basalts in the British Museum. Basalt is a stone much harder than marble and the Assyrians assuredly had tools softer than their Greek successors. They had, correspondingly, a greater difficulty in meeting the job which explains, no doubt, the low relief in which they worked. And yet those basalts moved me more than ever did the Elgin marbles or the other Greek pieces that I have seen in my time.

The modern oil painter is faced, I believe, with much the same kind of problem. There is certainly no objection to his

looking at the newer pigments nor to his soiling himself by the investigation of dye pots and dopes. But there is hazard in his belief that every increase in such closer approximation to physical nature heightens the quality of his artistic production. Wax figures are not art. Masks, confetti, bits of mirrors and whiskers stuck into pictures are not art. Nor is sophisticated dye chemistry mixed with unsophisticated painting technique, art. A lead pencil and the etching needle still run the camera into the background. The artist's goal is, in other words, not one hundred percent naturalism.

It is for such reasons that I cannot feel that art would be better served should the chemists, one day, give us pigments yielding one hundred percent spectral values. Such are not needed. It remains true that the first and greatest principle in art lies in arrangement. The second deals with light and shade. Color constitutes a poor third. Were this not so the masterpieces which have never known time nor place would be wrong.

Do the whitest paper and the blackest ink make the best pictures? Or do we step down the whites to creams and the blacks to grays? Unlimited length in keyboard seems not the indispensable element in harmony—and that is the thing, after all, which the artist is after.

BIBLIOGRAPHY

The painter seriously interested in the scientific foundations of his craft and his art will find the following articles and books not always easy reading but stimulating:

J. GAULD BEARN: *The Chemistry of Paints, Pigments and Varnishes*. London (1923).

A well written text on the subject covered by the title.

ERNST BERGER: *Beiträge zur Entwicklungsgeschichte der Maltechnik*. I, II, III, IV, V, München (1904, 1912, 1901, 1909).

A remarkable history; and a critical and experimental inquiry into the painting technique of bygone ages. The first volume deals with the painting of the Egyptians, Assyrians, Persians, East Indians, Greeks and Romans; the second with the origin and development of fresco, tempera and oil painting from the Byzantine period to the time of the VAN EYCKS; the third with the painting technique of the Renaissance to modern times. What time has spared of the classic texts, in all languages and on all manner of painting techniques is frequently translated and always carefully summarized. An unequalled contribution.

—— ——— *Böcklins Technik*. München (1906).

A critical and historic presentation of the exact technique followed by this master who, in fifty years of painting life, never wearied of trying to discover the best means of saying forever what he had to say. In trying to unravel the methods of the oldest painters he experimented and painted in tempera, oil tempera, varnish and oil on grounds of paper and cardboard as well as linen, covered with chalk. The master's methods of underpainting

with egg tempera covered by copal or mastic varnish and finished (while still moist) in oil color, in all forms from glazes to solid paint, are detailed. What time has done to his masterpieces is clearly set forth. An unequalled text for any modern student of the reasons for the failures and the successes of one man. An artist who for over fifty years as a painter and until his death in 1901 found it advisable to grind and purify all his own pigments, and to prepare all his own painting grounds and (tempera) media.

A. H. CHURCH: *The Chemistry of Paints and Painting*. Third Edition. London (1903).

The classic and still the best text on the chemistry of pigments, the methods of paint manufacture and the technique of painting. Apparently out of print in English. Available in the German translation of M. and W. OSTWALD, München (1908).

A. EIBNER: *Malmaterialienkunde als Grundlage der Maltechnik*. Berlin (1909).

—— — Über Fette Öle, Leinölersatzmittel und Ölfarben. München (1922).

The best recent studies of the effects of time, light, mixture and exposure upon the pigments, oils and varnishes used by the modern painter.

A. P. LAURIE: *The Painter's Methods and Materials*. Philadelphia (1926).

A confusedly written but interesting text discussing the methods and materials of the older masters. The attempt is made to indicate the value of these methods for the modern painter.

J. LEWKOWITSCH: *Chemical Technology and Analysis of Oils, Fats and Waxes*. Fifth edition, three volumes, London (1913-1915).

The great international text on the properties of the oils, fats and waxes used in paint manufacture.

FRIEDRICH LINKE und EMIL ADAM: *Die Malerfarben, Mal- und Bindemittel*. Third Edition, Esslingen a. N. (1913).

The best text on the subject that I know in German. After some introductory pages on chemistry for the technically untrained, all the pigments of the fine arts painter are considered seriatim with their multitudinous synonyms and trade names. There is discussed their chemical composition, their mode of preparation as paints, their permanence under different painting conditions, their sophistication and adulteration and the means of recognizing such. There are chapters, too, on the various oils and varnishes used in painting.

FRIEDRICH LINKE und ERNST BEUTEL: *Die Malerfarben, Mal- und Bindemittel*. Fourth Edition, Esslingen a. N. (1924).

A somewhat enlarged and revised edition of the preceding volume.

CHARLES MOREAU-VAUTHIER: *The Technique of Painting*. London (1912).

A presentation of the history of painting technique from Greco-Roman times to the present and in all its forms (tempera, fresco, oil-tempera, oil and water color). Not only are the pigments and their vehicles considered, but the methods of their use for the production of the different "styles" of painting. An almost encyclopedic presentation from which the producing artist must cull for himself what he thinks best.

WILHELM OSTWALD: *Kolloid-Zeitschrift* 16, 1, 1915; *ibid.* 17, 65, (1915).

These two articles constitute a first attempt to define in the terms of physics and chemistry the properties of the pigments used by artists to produce their color effects.

—— — *Einführung in die Farbenlehre*. Leipzig (1919).

The best book available on the physics and chemistry of the pigments and of the laws which govern the color impressions produced by such.

—— — *Die Farbenfibel*. Fifth Edition, Leipzig (1920).

A short and splendidly written text on the nature of pigments and colors. The author details the results of his own researches covering the classifica-

tion, properties and measurement of the color values of the various pigments. A classic.

WOLFGANG OSTWALD: *Kolloidchem. Beihefte* 2, 409, 1911; *Theoretical and Applied Colloid Chemistry*, second American edition, translated by FISCHER, 65, New York (1922); *Licht und Farbe in Kolloiden*, Dresden (1924).

In these articles and books the author states as a law the variations in color shown by one and the same substance when in different degrees of subdivision.

FRIEDRICH ROSE: *Die Mineralfarben*, Leipzig (1916).

An authoritative text on the history, preparation, properties and uses of the mineral pigments. The only text which deals adequately with the discovery and first use of naturally occurring mineral pigments and the later chemical development of this type of pigment.

ERNST STERN: *Kolloidchemische Grundlagen der Farbenbindemittel, Farbkörper und Anstrichfarben*. *Kolloidchem. Technologie*, edited by R. E. LIESEGANG, 322, Dresden (1927).

A review of the methods of pigment and paint production with an attempt to bring order into the empiric methods used on the basis of modern colloid chemistry.

MAXIMILIAN TOCH: *How to Paint Permanent Pictures*. New York (1922).

An excellent short text less conservative than these pages. Direct in its teaching method.

—— ——— *Chemistry and Technology of Paints*. Third Edition, New York (1925).

A good text on the chemical nature of pigments and on the methods employed in the manufacture of ready-to-use paints.

HANS WAGNER: *Farben-Zeitung* 29, 1503, 1547, 1597 (1924).

A classification of the pigments and paint vehicles in the terms of colloid chemistry.

A GLOSSARY OF PAINTERS' TERMS

A GLOSSARY OF PAINTERS' TERMS

This dictionary is intended for artists who wish to know the nature of the materials which they employ. Such a dictionary must have many shortcomings.

The first is its repetitive character, due to a multitude of names applied to one and the same substance. This evil began centuries ago when the colored "earths," because of shade or color differences (though of essentially the same chemical composition), were named after the places where they were first found; it has continued into our day when essentially similar or standard pigments and other artists' materials are named after the factories in which they are produced. Worse still, factory names have been devised which belie the character of the materials offered. Foreign names are applied to things made in the back-yard; the names of established and reliable pigments are used to cover up the nature of proprietary and evanescent ones; and the names of famous masters have been applied to messes which the masters never heard of. The word "permanent," too, is employed without regard to the conditions under which the paint may be used.

A second shortcoming is resident in the chemical analyses attached to the pigments. While it is easy enough to state what are the elements found in a given pigment, it is by no means settled as yet as to how these are tied together. The pigments were here before the chemical analyses and there is still much debate as to what in essence is responsible for those qualities in a pigment which make us choose it for work. At times the quantitatively major portion yields the color or character we are after, but sometimes it is some minor adventitious constituent or a peculiarity in the arrangement of the color-bearing element within the pigment itself.

GLOSSARY

ACACIA ARABICA.	The tree from which gum arabic is obtained. A binder frequently used in water-color or tempera.
ALBANOL.	Lithopone.
ALBUMEN.	The common name for egg-white.
ALBUMIN.	One of the great classes of the proteins and the most important constituent of milk, egg-white, etc. As such, one of the binders used in tempera painting.
ALIZARINE.	The modern synthetic chemical substitute ($C_{14}H_8O_4$) for red madder. The most light-fast of the lakes, but not completely so. Changes color when mixed with pigments carrying iron or much oxygen.
AMBER.	A fossil pine resin which forms the base of amber varnish.
ANILINE COLORS.	See aniline dyes.
ANILINE DYES.	The coal tar dyes. Strictly, the dyes first produced artificially from aniline, but now frequently applied to the dyes derived from naphthene, benzene, anthracene, toluene, phenol, cresol, etc. Practically none are light fast and all are chemically sensitive to admixture with other pigments (especially the mineral pigments). Used in water and oil painting as lakes, that is as white (or sometimes colored) earths stained by the dyes. There now exist several hundred of these under all sorts of names (both trade and chemical) and of every color from the purest rainbow to all types of hues and shades. Illustrative examples are indigo, cochineal red, gentian violet, brilliant yellow, fast red, fuchsine, rhodamine, Victoria blue, aniline black, etc.
ANILINE VIOLET.	See aniline dyes.
ANILINE YELLOW.	See aniline dyes.
ANTWERP BLUE.	Berlin blue.
ASPHALT.	See bitumen.
AUREOLIN.	A double nitrite of cobalt and potassium. On account of the latter, somewhat water solu-

AURIPIGMENT.	ble. It decomposes of itself and decomposes other pigments, like the lakes. To be avoided in oil painting.
AZO YELLOW.	Orpiment.
AZURE BLUE.	See Indian yellow.
AZURITE.	Ultramarine.
AZZURRO DELLA MAGNA.	Native copper carbonate (used by some masters of the 15th to 17th centuries).
BALSAM.	Azurite.
BARIUM CHROMATE.	The oil or resin flowing naturally or obtained by incision of various shrubs or trees.
BARIUM WHITE.	Lemon yellow.
BARIUM YELLOW.	Barium sulphate.
BEEWAX.	Barium chromate.
BERLIN BLUE.	Honeycomb wax. A complicated "fat."
BISTER.	Iron ferrocyanide.
BITUMEN.	Prepared by extracting tar, soft coal or humus and related to bitumen. Not light fast; deep brown coloring matter when fresh, but fugitive.
BLACK.	A mixture of (black) hydrocarbons; natural in Trinidad, etc.; soluble in oil and transparent; perishes in light; creeps and "comes through"; bad drier.
<i>Aniline.</i>	A coal tar derivative, best not employed.
<i>Bone.</i>	Carbon.
<i>Ivory.</i>	Carbon.
<i>Lamp.</i>	Carbon.
BLANC FIXÉ.	Barium sulphate.
BLOOD RED.	Iron oxide.
BLUE.	
<i>Antwerp.</i>	Berlin blue.
<i>Azure.</i>	Ultramarine.
<i>Berlin.</i>	Iron ferrocyanide.
<i>Cerulean.</i>	Essentially an oxide of cobalt with tin oxide (cobalt stannate?).
<i>Chinese.</i>	Berlin blue.
<i>Cobalt.</i>	Essentially an oxide of cobalt with aluminium oxide.
<i>Cölin.</i>	Cerulean blue.
<i>Cyanine.</i>	Mixture of Berlin blue and cobalt blue.
<i>Dumont's.</i>	Smalt
<i>French.</i>	Ultramarine.
<i>King's.</i>	Smalt.
<i>Leitch's.</i>	Mixture of Berlin blue and cobalt blue.

<i>Leyden.</i>	Cobalt blue.
<i>Mineral.</i>	Berlin blue.
<i>Mountain.</i>	Basic copper carbonate; occurs naturally in azurite, now made artificially; turns green with time, due to the production of copper soaps.
<i>New.</i>	Ultramarine.
<i>Oriental.</i>	Ultramarine.
<i>Paris.</i>	Berlin blue; iron ferrocyanide.
<i>Permanent.</i>	Ultramarine.
<i>Prussian.</i>	Berlin blue.
<i>Saxon.</i>	Berlin blue.
<i>Steel.</i>	Berlin blue.
<i>Thenard's.</i>	Cobalt blue.
<i>Turnbull's.</i>	Berlin blue.
<i>Ultramarine.</i>	Originally lapis lazuli, now made artificially; probably colloidal sulphur in a glass-like matrix.
<i>Zaffer.</i>	Smalt.
BLUE GREEN OXIDE.	Mixtures of chromium oxide and aluminium oxide with cobaltous oxide.
BOHEMIAN EARTH.	Terra verde.
BOILED OIL.	Usually boiled <i>linseed</i> oil. When boiled <i>without</i> "driers" it polymerizes and thickens, constituting Dutch "stand" oil. Most commonly the linseed oil is boiled with lead compounds and the finished product then contains considerable fractions of this element. Sometimes manganese compounds are used. The best carry cobalt.
BONE BLACK.	Ivory black.
BONE BROWN.	Incompletely charred ivory black; not permanent.
BRONZE GREEN.	See green vermillion.
BROWN.	Incompletely charred ivory black; not permanent.
<i>Bone.</i>	Umber (?) ; van Dyke brown.
<i>Caledonian.</i>	Umber (?) ; van Dyke brown.
<i>Cappah.</i>	Van Dyke brown.
<i>Cassel.</i>	Umber.
<i>Chestnut.</i>	Van Dyke brown.
<i>Cologne.</i>	Copper ferrocyanide; bad.
<i>Florentine.</i>	See Florentine brown.
<i>Hatchet's.</i>	Umber.
<i>Manganese.</i>	Mars yellow.
<i>Mars.</i>	Umber.
<i>Plush.</i>	Florentine brown.
<i>Roman.</i>	

<i>Soot.</i>	See bister.
<i>Spanish.</i>	Van Dyke brown.
<i>Van Dyke.</i>	A peat; contains organic material and iron oxide; fades in the light.
BROWN LAKE.	See bister.
BROWN OCHRE.	Hydrated iron oxide.
BROWN PINK.	Yellow lake.
BURNT OCHRES.	Yellow ochres heated; iron hydroxide or iron oxide with the water removed from the original "earth."
BURNT SIENA.	Burnt ochre.
BURNT UMBER.	Raw umber heated.
CADMIUM RED.	Cadmium sulphide with cadmium selenide ($\text{CdS} + \text{CdSe}$); a substitute for vermilion but less brilliant.
CADMIUM YELLOW.	Cadmium sulphide (CdS); the three kinds, light, middle and orange are chemically identical but more coarsely granular in the order named.
CALEDONIAN BROWN.	Should be an umber and so permanent; often a mixture with van Dyke brown which ruins it.
CANADA BALSAM.	The resin of a Canadian pine.
CAPPAH BROWN.	When pure, an umber; often mixed with van Dyke brown and ruined.
CAPUT MORTUUM.	Jeweller's rouge produced by heating iron sulphate. The rouge is essentially iron oxide, permanent, and of the quality of red ochre or Mars red.
CARMINE.	Extract of cochineal; turns purple on heating; not fast to light; easily changed by many mineral pigments.
CARMINE LAKE.	Cochineal precipitated upon aluminium hydroxide; see carmine.
CASEIN.	The curd of milk.
CASSEL BROWN.	Van Dyke brown.
CERULEAN BLUE.	Essentially an oxide of cobalt with tin oxide (cobalt stannate?).
CHALK.	Calcium carbonate (CaCO_3).
CHESTNUT BROWN.	Umbre.
CHINA CLAY.	A hydrous aluminium silicate, absolutely permanent, low covering power; much used as base for lakes and for a filler in prepared paints.

CHINESE BLUE.	Berlin blue.
CHINESE PERMANENT WHITE.	Zinc oxide. The name is sometimes given to lithopone.
CHINESE VERMILION.	Natural vermilion of China.
CHINESE WHITE.	Zinc oxide.
CHREMnitz WHITE.	Lead carbonate.
CHROME GREEN.	Mixtures of green with yellow, most commonly the cheapest and worst of each, namely Berlin blue and chrome yellow; not to be confounded with chromium green which is chromium oxide and excellent.
CHROME OCHRE.	Yellow ochre mixed with chrome yellow; the second is lead chromate and bad.
CHROME ORANGE.	Chrome yellow treated with sodium hydroxide which coarsens the pigment particles; darkens on exposure to air.
CHROME RED.	Chrome yellow digested with sodium hydroxide; a still coarser form of lead chromate; blackens on exposure to air.
CHROME YELLOW (CITRON).	Lead chromate precipitated with lead sulphate; bad because of its lead content.
CHROME YELLOW (LIGHT).	Lead chromate (PbCrO_4); bad because a lead pigment.
CHROMIUM OXIDE GREEN (DULL).	An oxide of chromium; permanent. Do not confuse with chrome green.
CHROMIUM OXIDE GREEN (TRANSPARENT).	A hydrated chromium oxide; permanent; discovered by PANNETIER in 1838 and rediscovered by GUIGNET later. Do not confuse with chrome green.
CITRON CHROME YELLOW.	Lead chromate precipitated with lead sulphate; bad because of its lead content.
CITRON YELLOW.	Chrome yellow.
CLAY.	A natural white earth somewhat transparent; chemically it is aluminium silicate with more or less water.
COAL TAR.	The distillate from soft coal; an oily mixture from which are obtained aniline, benzene, anthracene, etc. out of which the coal tar dyes are manufactured.
COAL TAR DYES.	See aniline dyes.

COBALT.*Blue.*Essentially an oxide of cobalt with aluminium oxide (CoO and Al_2O_3).*Green.*

Cobaltous oxide with zinc oxide; transparent and absolutely fast; known also as RINMANN'S green who discovered it in the 18th century.

Ultramarine.

Cobalt blue.

Violet.

An anhydrous phosphate of cobalt; when such, absolutely permanent. What is frequently sold as cobalt violet is an arsenate of cobalt which grays or goes black.

Yellow.

Aureolin.

CÖLIN BLUE.

Cerulean blue.

COLOGNE.*Brown.*

Van Dyke brown.

Earth.

Van Dyke brown.

COMPLEMENTARY COLORS.Rainbow colors which when the reflected *light* from them is mixed, yield the sensation *white* (gray); for example, yellow with pure blue, bright red with sea green, violet with leaf green, etc.**COPAIBA BALSAM.**

A resinous oil obtained from several species of the South American copaiba tree.

COPAL.

A hard clear African resin used in varnish manufacture. Some brands seem derived from trees (related to copaiba); others seem half fossil (related to amber) and are picked up in the streams of Africa.

COPPER CARBONATE.

As a modern pigment, a weak blue; and bad in mixture with other pigments especially those containing sulphur. The native azurite employed by some of the older masters was a stronger blue and because housed in glass, was permanent when mixed.

COPPERAS.Ferrous sulphate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$); the crude material from which many of the iron pigments (like Mars red, Venetian red, etc.) are prepared.**CORK BLACK.**

Carbon black.

CREMSER WHITE.

Lead carbonate.

CYANINE BLUE.

Mixture of Berlin blue and cobalt blue; not good.

CYPRIAN UMBER.

Raw umber.

DAFFODIL YELLOW.

Cadmium yellow containing some oxide of magnesium.

DAMMAR.

A pine resin of Australia and the East Indies

- DIAMOND WHITE. resembling copal and used in varnish manufacture.
- DRIERS. Lithopone.
- DRYING AGENTS. See drying agents.
- DRYING OILS. Materials added to "drying" oils which hasten the process; really a method for hastening their oxidation; various pigments (like those of iron) already do this; lead, manganese and cobalt salts work even faster, and these are the dopes usually sold as "driers." All are bad, the cobalt least so.
- DUMONT'S BLUE. Oils which on exposure to air become oxidized, thus changing from a liquid to a glasslike solid. Linseed oil is the standard example; others of the class are poppy oil, walnut oil, perilla oil, tung oil, sunflower oil.
- DUTCH STAND OIL. Smalt.
- A linseed oil boiled without the addition of any "drier." The oil polymerizes, becomes thicker and dries somewhat faster. Sometimes called a "varnish" or "lithographer's varnish." Thinned with turpentine, it is probably the "varnish" used by RUBENS over his pictures. A material which the modern oil painter could well afford to reintroduce into his technique.
- EARTH.
- Bohemian.* Terra verde.
- Cologne.* Van Dyke brown.
- Synoptic.* Red ochre.
- Venetian.* Terra verde.
- EGG MEDIUM. The yolk of the egg or the whole egg; used as a binder in tempera painting. Egg yolk contains naturally about 35 percent of "fat" and therefore in itself approximates an oil-egg medium. The fat fraction may be increased by stirring oil or varnish into the egg yolk. Such is the basis of oil tempera. When first made, the emulsion mixes with water and (mixed with pigment) may be used as a water color; when the water has evaporated, the oil is left behind and the color will now no longer mix with water but will mix with oil.
- EMERALD GREEN. Copper arsenite; perishable.
- EMULSIONS. Permanent subdivisions of one liquid in a second, as oil in water (milk) or water in

ENGLISH GREEN.	oil (butter). The emulsions of the tempera painters are of the first order, changing to the second on drying.
FIG JUICE.	See Schweinfürt green.
FLAKE WHITE.	A type of emulsion; see emulsions.
FLORENTINE.	Lead white.
<i>Brown.</i>	Copper ferrocyanide; bad.
<i>Lake.</i>	Cochineal lake; very bad.
FRANKFORT BLACK.	Vine black; a carbon black.
FRENCH BLUE.	Artificial ultramarine.
FRESCO.	A form of "painting" in which the colored pigments are held together by lime (calcium carbonate).
FUGITIVE PIGMENTS.	Colored pigments which charm but fade. Some simply evaporate, others lose their bloom, and all allow the naked truth to come out once more. Most of the modern color-man's stock in trade.
GAMBOGE.	A resin; usually used as a lake; non-permanent.
GERANIUM LAKE.	An eosine lake and the worst. See aniline colors.
GESSO.	Plaster; now pretty much any kind of white background. The white background of the old masters was chalk (calcium carbonate) or plaster of Paris (calcium sulphate or gypsum).
GILDING.	The application of metallic gold as a leaf or powder to a prepared surface. A binder (a varnish) is applied to the surface to be covered, or mixed with the gold powder. When what glitters is not gold, it is usually tombac (brass).
GLUE.	Gelatine; the sticky product produced by boiling the skins or hoofs of various animals.
GOLD OCHRE.	Yellow ochre.
GRAPHITE.	Carbon.
GREEN.	
<i>Bronze.</i>	See green vermillion.
<i>Chrome.</i>	See chrome green.
<i>Chromium Oxide (Dull).</i>	Cr_2O_3 ; permanent.
<i>Chromium Oxide (Transparent).</i>	Hydrated chromium oxide; permanent.
<i>Cobalt.</i>	An oxide of cobalt with zinc oxide; absolutely fast.

<i>Emerald.</i>	Copper arsenite; bad.
<i>English.</i>	See Schweinfürt green.
<i>Guignet's.</i>	Transparent green chromium oxide.
<i>Hooker's.</i>	Mixture of Berlin blue with gamboge and therefore worthless.
<i>King's.</i>	See Schweinfürt green.
<i>Leipzig.</i>	See Schweinfürt green.
<i>Meadow.</i>	See Schweinfürt green.
<i>Mineral.</i>	See Schweinfürt green.
<i>Moss.</i>	See green vermillion.
<i>Mountain.</i>	Basic copper carbonate; obtained from the mineral malachite.
<i>Nürnberg.</i>	Mixture of chromium oxide and zinc yellow.
<i>Oil.</i>	See green vermillion.
<i>Olive.</i>	See green vermillion.
<i>Paris.</i>	See Schweinfürt green.
<i>Parrot.</i>	See Schweinfürt green.
<i>Patent.</i>	See Schweinfürt green.
<i>Permanent.</i>	Transparent green chromium oxide with barium sulphate; the lighter tints are mixtures of chromium oxide with zinc yellow. The painter can better make them himself.
<i>Prussian.</i>	Mixtures of Berlin blue and gamboge; bad.
<i>Rinmann's.</i>	Cobalt green.
<i>Sap.</i>	Mixtures of Berlin blue and gamboge; bad.
<i>Scheele's.</i>	Copper arsenite; poisonous; for properties, see Schweinfürt green.
<i>Schweinfürt.</i>	Emerald green; not to be confused with vert emeraude; Paris green; essentially copper arsenite containing some copper acetate; poisonous; goes black in mixture with the cadmiums and in polluted air.
<i>Silk.</i>	See green vermillion.
<i>Smaragd.</i>	Transparent green chromium oxide; permanent.
<i>Swedish.</i>	Schweinfürt green.
<i>Tyrolean.</i>	Terra verde.
<i>Véronèse.</i>	Schweinfürt green. See also Veronese green.
<i>Victoria.</i>	Mixture of chromium oxide and zinc yellow.
<i>Viennese.</i>	See Schweinfürt green.
<i>Zinc.</i>	Cobalt green.
<i>Zinnober.</i>	See chrome green, a mixture.
GREEN BLUE OXIDE.	See blue green oxide.
GREEN OCHRE.	Should be terra verde. Frequently a mixture and then worthless.
GREEN VERMILION.	Mixtures, usually bad, travelling on the reputation of vermillion, and containing none of it. Most commonly mixtures of Berlin blue with yellow pigments; sometimes they are better

- and consist of chromium oxide, or ultramarine with yellow pigments.
- GUIGNET'S GREEN.** Green chromium oxide; permanent.
- GUM ARABIC.** The gum from certain species of acacia; a common binder in water color technique.
- HAMBURG WHITE.** White lead mixed with more than 50 per cent barium sulphate.
- HATCHET'S BROWN.** See Florentine brown.
- HEMPSEED OIL.** One of the "drying" oils used in oil painting.
- HONEY.** The nectar of flowers as gathered by bees; a viscid mixture of sugars (chiefly levulose and dextrose); used as an adjuvant to the binder of water colors. Originally employed by the old masters in tempera.
- HOOKE'S GREEN.** Mixture of Berlin blue and gamboge; worthless.
- INDIAN RED.** Iron oxide.
- INDIAN YELLOW.** A magnesium salt of xanthic acid; the dye stuff is obtained from the urine of cows fed certain plants, in India; today the name Indian yellow may be found applied to aniline lakes, like naphthol yellow or azo yellow, that never saw a cow, India, or xanthic acid.
- INDIGO.** Originally the dye stuff obtained from various tropical plants (*Indigofera*), but now made artificially from coal tar (naphthalene); worthless as a pigment.
- INDIGO CARMINE.** Sodium indigosulphonate; beautiful, but worthless as a pigment.
- IRON OXIDE COLORS (RED).** Bright red to blood red to dark violet; some are natural ores ground into pigments; closely related to the natural red ochres; the brightest iron oxide pigments are prepared artificially. See Mars colors.
- ITALIAN PINK.** Yellow lake.
- IVORY BLACK.** Carbon.
- JAUNE BRILLANT.** Cadmium yellow mixed with lead white.
- KING'S.** Smalt.
- Blue.* See Schweinfürt green.
- Green.* Usually chrome yellow; originally the trisulphide of arsenic and a substitute for the orpiment of the old masters. Bad in either case.
- Yellow.*
- KREMnitz WHITE.** Lead white.

- LAC.** The crude mixture of resin and insects from which is obtained a resin (shellac) and a red coloring matter (lac dye). Shellac is to be rated with the varnishes, and the dye substances with the poorer grades of red lakes.
- LAKE.**
- Brown.* See bister.
 - Carmine.* Cochineal lake.
 - Florentine.* Cochineal lake.
 - Munich.* Cochineal lake.
 - Paris.* Cochineal lake.
 - Purple.* Cochineal lake treated with calcium salts before precipitation.
 - Rembrandt's.* Madder lake.
 - Rubens'.* Madder lake.
- LAKES.** Fundamentally dye substances made to stain various earths; the earths are usually white but may be colored.
- LAMP BLACK.** Carbon.
- LAVENDER OIL.** Used by some artists in place of turpentine.
- LEAD SULPHATE.** A lead white, less poisonous than the ordinary lead white which is lead carbonate; has little or none of the tenacious, "pully" quality of ordinary white lead and goes yellow or black with time though more slowly.
- LEAD WHITE.** Essentially lead carbonate, though actually it may carry as much as 30 percent of lead oxide (or hydroxide).
- LEIPZIG GREEN.** See Schweinfürt green.
- LEITCH BLUE.** Mixture of Berlin blue and cobalt blue.
- LEMON YELLOW.** Barium chromate.
- LEYDEN BLUE.** Cobalt blue.
- LIGHT OCHRE.** A variety of yellow ochre.
- LIGHT RED.** Natural red ochre.
- LIME.** Calx, quicklime, or burned lime, is calcium oxide (CaO); when mixed with water, it gets hot, swells and becomes slaked lime, calcium hydroxide (Ca(OH)_2); air slaked lime contains calcium carbonate (CaCO_3) in addition. Mortar is freshly slaked lime mixed with three or four times its quantum of sand. Lime is a definitely alkaline material, which explains why so few pigments are left unaffected by it in true fresco painting.
- LINOLENIC ACID.** One of the constituents in linseed (and other) oils, which gives them their "drying" properties.

LINSEED OIL.	The oil prepared from flaxseed and the most important of the "drying" oils used in oil painting.
LITHOPONE.	Mixture of barium sulphate and zinc sulphide.
MADDER. <i>Carmine.</i>	Mixture of alizarine and carmine lakes made more beautiful and worse for the painter by the carmine.
<i>Red.</i>	See alizarine.
<i>Violet.</i>	See alizarine.
<i>Yellow.</i>	Yellow lake; worthless.
MAGENTA RED.	See aniline dyes.
MAHOGANY.	A wood much used for painting grounds because of its resinless character.
MALACHITE.	The mineral, copper carbonate. The natural product was used by the old masters and was not bad (because housed in a glassy matrix?). The modern chemically produced material is dangerous on the palette.
MANGANESE. <i>Brown.</i> <i>Violet.</i>	Umber. The double phosphate of manganese and ammonia; said to be permanent; but questionable.
MARS. <i>Brown.</i>	See Mars yellow; an artificially produced ochre; an hydroxide or oxide of iron mixed with zinc or aluminium salts.
<i>Orange.</i>	Artificial iron oxide hydrate, dried.
<i>Violet.</i>	Essentially iron oxide.
<i>Yellow.</i>	Artificially produced yellow ochre; an iron hydroxide or iron oxide, in or with zinc or aluminium salts.
MARS PIGMENTS.	A series of iron hydroxides or oxides varying in color from yellow to orange to red to purple, produced artificially by roasting various iron salts. A beautiful permanent series of practically identical chemical composition. The various "tones" seem dependent upon the degree of fineness of the iron particles.
MASSICOT.	A yellow lead oxide.
MASTIC.	The resin from the pistacia tree found on the Island of Chios and used in varnish manufacture.
MAUVE.	See aniline dyes.
MEADOW GREEN.	See Schweinfürt green.

MINERAL.	
<i>Blue.</i>	Berlin blue.
<i>Green.</i>	See Schweinfürt green.
<i>Violet.</i>	Manganese violet.
<i>Yellow.</i>	Basic lead chloride; a worthless yellowish pigment; substituted at times for Naples yellow, which is lead antimonate.
MINIUM.	A lead oxide (Pb_3O_4).
MOSS GREEN.	See green vermilion.
MOUNTAIN.	
<i>Blue.</i>	Basic copper carbonate; occurs naturally in azurite; now made artificially; turns green with time (due to the production of copper soaps?).
	A basic copper carbonate obtained from the mineral malachite.
<i>Green.</i>	
MUMMY.	The asphalt used in embalming mummies, mixed with the accompanying earth and worked into a paint. As bad as the asphalt it contains.
MUNICH LAKE.	Cochineal lake; worthless.
NAPHTHOL YELLOW.	A substitute for Indian yellow, and worse.
NAPLES.	
<i>Red.</i>	Red ochre.
<i>Yellow.</i>	Lead antimonate; but light brands of yellow ochre or mixtures of zinc yellow with various earths are sold under this name.
NATURAL RED OCHRE.	Oxide of iron in an earthy matrix.
NEW BLUE.	Ultramarine.
NÜRNBERG.	
<i>Green.</i>	A mixture of chromium oxide and zinc yellow.
	Manganese violet.
<i>Violet.</i>	
OCHRE.	The name of a natural earth varying in color from yellow to red to violet; the color is due to the iron compounds the earth contains, either the hydroxide or the oxide or both.
OCHRE.	
<i>Brown.</i>	Yellow ochre.
<i>Burnt.</i>	Yellow ochre heated; it is generally said that the (yellow) iron hydroxide is converted into the (redder) iron oxide.
	Yellow ochre mixed with chrome yellow; bad because of the mixture.
<i>Chrome.</i>	
	Yellow ochre.
<i>Gold.</i>	A mixture, unless it is true terra verde.
<i>Green.</i>	A variety of yellow ochre.
<i>Light.</i>	

<i>Middle.</i>	Yellow ochre.
<i>Natural Red.</i>	An oxide of iron in an earthy matrix.
<i>Roman.</i>	Yellow ochre.
<i>Yellow.</i>	Iron hydroxide or hydrated iron oxide.
OIL.	A fat which is liquid at ordinary temperatures; scientifically, a compound of a fatty acid with an alcohol. The oils and fats of nature contain many different fatty acids, but the alcohol is most commonly glycerine.
OIL GREEN.	See green vermilion.
OLIVE GREEN.	See green vermilion.
ORANGE.	
<i>Cadmium.</i>	See cadmium orange.
<i>Chrome.</i>	Chrome yellow digested with sodium hydroxide; very bad.
<i>Vermilion.</i>	See vermilion.
ORIENTAL BLUE.	Ultramarine.
ORPIMENT.	The old name for the naturally occurring mineral (yellow) trisulphide of arsenic (As_2S_3).
ORR'S WHITE.	Lithopone.
OXIDE OF CHROMIUM.	The chemical name for vert emeraude or viridian.
OXIDE, RED IRON COLORS.	See iron oxide colors (red).
PAINTER'S WHITE.	Chalk; calcium carbonate.
PARIS BLUE.	Iron ferrocyanide.
PARIS GREEN.	Schweinfürt green.
PARIS LAKE.	Cochineal lake.
PARIS RED.	Minium; lead oxide (Pb_3O_4).
PARIS WHITE.	Chalk; calcium carbonate.
PARIS YELLOW.	Chrome yellow plus plaster of Paris.
PARROT GREEN.	See Schweinfürt green.
PATENT GREEN.	See Schweinfürt green.
PERMALBA.	Proprietary name for a titanium white.
PERMANENT BLUE.	Ultramarine.
PERMANENT GREEN.	Transparent green chromium oxide plus barium sulphate (BaSO_4); the yellower shades are mixtures of this with zinc yellow. These mixtures are good, but other mixtures of blues with yellows and not so good frequently go under the name.
PERMANENT WHITE.	Barium sulphate (BaSO_4).
PERMANENT WHITE (CHINESE).	Zinc oxide and sometimes lithopone.

PERMANENT YELLOW.	Barium chromate.
PERSIAN RED.	Iron oxide.
PERSIAN YELLOW.	See aniline dyes.
PETROLEUM.	Kerosene; a non-drying but evaporating fraction of mineral oil; a mixture of various hydrocarbons.
PIGMENT.	A powder or a paint which reflects light. When all of ordinary light is reflected the pigment is said to be white; when only certain portions are reflected, the pigment is colored. See colors.
PINK.	
<i>Brown.</i>	Yellow lake.
<i>Dutch.</i>	A lake prepared from Persian berries.
<i>Italian.</i>	Yellow lake.
PLASTER.	See lime.
PLASTER OF PARIS.	Calcium sulphate.
PLUSH BROWN.	Umber.
POMPEIAN RED.	Iron oxide.
POPPY OIL.	A drying oil.
PRUSSIAN BLUE.	Berlin blue.
PRUSSIAN GREEN.	Mixture of Berlin blue and gamboge; bad.
PURPLE LAKE.	Cochineal lake treated with calcium salts before precipitation; worthless.
QUICKLIME.	See lime.
RAW SIENA.	A natural ochre.
RAW UMBER.	A natural ochre carrying some manganese.
REALGAR.	The old name for the naturally occurring red disulphide of arsenic (As_2S_2).
RED.	
<i>Blood.</i>	Iron oxide.
<i>Caesar.</i>	Iron oxide.
<i>Chrome.</i>	Chrome yellow digested with sodium hydroxide.
<i>Light.</i>	Natural red ochre.
<i>Magenta.</i>	See aniline dyes.
<i>Naples.</i>	Red ochre.
<i>Natural Ochre.</i>	Oxide of iron in an earthy matrix.
<i>Persian.</i>	Iron oxide.
<i>Pompeian.</i>	Iron oxide.
<i>Saturn.</i>	Minium, a lead oxide (Pb_3O_4).
<i>Turkey.</i>	Iron oxide.
<i>Van Dyke.</i>	Iron oxide.
<i>Venetian.</i>	Natural red ochre; essentially iron oxide.
<i>Viennese.</i>	See chrome red.

RED IRON OXIDE COLORS.	See iron oxide colors (red).
RED LAKE.	See aniline colors.
RED MADDER.	See alizarine.
RED OCHRE.	Iron oxide.
REMBRANDT'S LAKE.	Madder lake.
RESINS.	The (usually) solid, transparent or translucent exudate from various plants, insoluble in water but soluble in various oils, turpentine, etc. Of varying and complex chemical composition. Used in the production of varnish.
RINMANN'S GREEN.	Cobalt green.
ROMAN BROWN.	Florentine brown.
ROMAN OCHRE.	Yellow ochre.
ROSE SOLFERINO.	See aniline colors.
ROSIN.	Pine resin. See resins.
RUBENS' LAKE.	Madder lake.
RUBRICA.	Red ochre.
SANDARAC.	A resin used in certain varnishes.
SAP GREEN.	A mixture of Berlin blue with gamboge; bad.
SATURN RED.	Minium; lead oxide (Pb_3O_4).
SAXON BLUE.	Berlin blue.
SCARLET VERMILION.	An iodide of mercury (HgI_2) and not to be confused with true vermilion which is a sulphide. A beautiful but evanescent red which should not be employed.
SCHEELE'S GREEN.	Copper arsenite; see Schweinfürt green.
SCHWEINFÜRT GREEN.	Essentially copper arsenite containing some acetate.
SEPIA.	Ink of the squid; not light fast.
SIENA.	
<i>Burnt.</i>	A burnt ochre.
<i>Terra.</i>	A yellow ochre.
SILK GREEN.	See green vermilion.
SILVER WHITE.	Lead carbonate.
SMALT.	The oldest cobalt color, being a pulverized cobalt glass. Used by some masters after its discovery in 1700.
SMARAGD GREEN.	Transparent green chromium oxide.
SNOW WHITE.	Zinc oxide and sometimes lithopone.
SOLFERINO ROSE.	See aniline colors.
SOOT BROWN.	See bister.
SPANISH BROWN.	Van Dyke brown.

SPECTRUM.	The "rainbow" which results when ordinary white light is passed through a prism.
SPIKE OIL.	Lavender oil; a thin oil used in place of turpentine.
SPIRIT VARNISHES.	A resin dissolved in alcohol, turpentine, or some other volatile liquid.
SPIRITS OF TURPENTINE.	The purified (by steam) thin clear distillate of the resin of various coniferous trees; in America, the long leaved pine; in Europe, the larch, etc.
STAND OIL.	See Dutch stand oil.
STEEL BLUE.	Berlin blue.
STRONTIUM YELLOW.	Strontium chromate.
SWEDISH GREEN.	See Schweinfürt green.
SYNOPTIC EARTH.	Red ochre.
TERRA POZZUOLI.	Venetian red.
TERRA ROSSA.	Venetian red.
TERRA SIENA.	Yellow ochre.
TERRA VERDE.	An earth, essentially an ochre, which owes its green color to iron silicate; some manufacturers have not hesitated to dye yellow ochre with coal tar dyes to imitate this pigment.
TERRE VERTE.	Terra verde.
THENARD'S BLUE.	Cobalt blue.
TURKEY RED.	Iron oxide.
TURNBULL'S BLUE.	Berlin blue.
TURNER'S YELLOW.	See mineral yellow.
TYROLEAN GREEN.	Terra verde.
ULTRAMARINE.	Originally lapis lazuli, now made artificially; probably colloidal sulphur in a glass-like matrix.
<i>Blue.</i>	
<i>Cobalt.</i>	Cobalt blue.
<i>Yellow.</i>	Sometimes barium chromate and sometimes zinc chromate, and in neither instance related to ultramarine.
UMBER.	An earth and essentially an iron color, but mixed with manganese oxide.
<i>Burnt.</i>	Raw umber heated.
<i>Cyprian.</i>	Raw umber.
VAN DYKE.	Earth from a peat district, the latter yielding organic materials which give agreeable "warm" tones and then fade.
<i>Brown.</i>	

<i>Red.</i>	Iron oxide; madder. The painter should know which.
VARNISH.	A resin dissolved in a volatile solvent (spirit varnish) or in an oil (oil varnish). Sometimes applied to linseed oil boiled with a "drier" (linseed oil varnish).
VENETIAN.	
<i>Earth.</i>	Terra verde.
<i>Red.</i>	Natural red ochre.
<i>White.</i>	White lead with 50 percent barium sulphate.
VERDIGRIS.	Essentially copper acetate; unites with the oils in oil painting to form copper soaps which turn blue and disintegrate.
VERMILION.	Sulphide of mercury. The orange, carmine and violet varieties or the light and dark shades of this pigment seem to be determined by its fineness of subdivision. Said to be not entirely fast to light. It is more probable that the darkening noted is due to time and the aggregation of the finer (orange) particles into coarser ones (violet).
<i>Chinese.</i>	Vermilion of China, a sulphide of mercury.
<i>Scarlet.</i>	An <i>iodide</i> of mercury (HgI_2); more beautiful than Chinese vermilion but evanescent; not to be confused with the true vermilion.
VERONESE GREEN.	The earth of Verona is terra verde; the vert Paul Véronèse is emerald green (which see) and bad.
VERT EMERAUDE.	The green oxide of chromium; absolutely reliable.
VERT PAUL VÉRONÈSE.	See Schweinfürt green.
VICTORIA GREEN.	A mixture of chromium oxide and zinc chromate; by itself not altogether bad.
VIENNESE.	
<i>Lake.</i>	Cochineal lake; worthless.
<i>Red.</i>	Chrome red; worthless.
<i>White.</i>	Chalk.
VIOLET.	
<i>Aniline.</i>	See aniline dyes.
<i>Cobalt.</i>	An anhydrous phosphate of cobalt; see cobalt violet.
<i>Manganese.</i>	Double phosphate of manganese and ammonia; said to be permanent, but subject to question.
<i>Mars.</i>	Iron oxide.
<i>Mineral.</i>	Manganese violet.
<i>Nürnberg.</i>	Manganese violet.

- VIOLET LAKE.** See aniline dyes.
- VIOLET MADDER.** See alizarine.
- VIRIDIAN.** The transparent green oxide of chromium.
- WALNUT OIL.** A type of drying oil.
- WATER COLORS.** Pigments held together by a water soluble gum of some sort. Gum arabic is commonly used with various additions like sugar and glycerine.
- WAX.** Fats of high melting point. See oils and bees-wax.
- WHITE.**
- Barium.* Barium sulphate.
 - Chinese.* Zinc oxide.
 - Chinese Permanent.* Zinc oxide; sometimes lithopone.
 - Chremnitz.* Lead carbonate.
 - Cremser.* Lead carbonate.
 - Diamond.* Lithopone.
 - Griffith's.* Lithopone.
 - Hamburg.* White lead mixed with much barium sulphate.
 - Lead.* About 70 percent lead carbonate with 30 percent lead oxide (or hydroxide).
 - Orr's.* Lithopone.
 - Painter's.* Chalk; calcium carbonate.
 - Paris.* Chalk; calcium carbonate.
 - Permanent.* Barium sulphate (BaSO_4).
 - Silver.* Lead carbonate.
 - Snow.* Zinc white and sometimes lithopone.
 - Venetian.* White lead with 50 percent barium sulphate.
 - Viennese.* Chalk; calcium carbonate.
 - Zinc.* Zinc oxide.
- YELLOW.**
- Aniline.* See aniline dyes.
 - Azo.* See Indian yellow.
 - Barium.* Barium chromate.
 - Cadmium.* Cadmium sulphide.
 - Chrome.* Lead chromate (PbCrO_4).
 - Citron.* Chrome yellow.
 - Citron Chrome.* Lead chromate precipitated with lead sulphate.
 - Cobalt.* See aureolin.
 - Indian.* See Indian yellow.
 - King's.* Usually chrome yellow; originally the trisulphide of arsenic.
 - Lemon.* Barium chromate.
 - Mars.* Artificially produced yellow ochre.
 - Mineral.* Basic lead chloride; bad; a substitute for Naples yellow, which is lead antimonate and also bad.

<i>Naphthol.</i>	A bad coal tar substitute for Indian yellow which is also bad.
<i>Naples.</i>	Lead antimonate; goes gray.
<i>New.</i>	Chrome yellow plus barium sulphate; bad.
<i>Paris.</i>	Chrome yellow plus plaster of Paris; bad.
<i>Permanent.</i>	Barium chromate.
<i>Persian.</i>	See aniline dyes.
<i>Strontium.</i>	Strontium chromate.
<i>Turner's.</i>	See mineral yellow.
<i>Ultramarine.</i>	Barium chromate, sometimes zinc chromate and never anything related to ultramarine.
<i>Zinc.</i>	Essentially zinc chromate.
YELLOW LAKE.	The yellow extract of various plants used to stain a white "earth" of some kind.
YELLOW MADDER.	Yellow lake.
YELLOW OCHRE.	Hydrated iron oxide or iron hydroxide.
ZAFFER BLUE.	Smalt.
ZINC CHROMATE.	Zinc yellow.
ZINC GREEN.	Cobalt green.
ZINC WHITE.	Zinc oxide.
ZINC YELLOW.	Essentially zinc chromate.
ZINNOBER GREEN.	See chrome green, a mixture.

The permanent palette

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